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**Larvae of the
Nearctic Larentiinae
(Lepidoptera: Geometridae)**

by

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THE CANADIAN ENTOMOLOGIST

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Larvae of the Nearctic Larentiinae (Lepidoptera: Geometridae)^{1 2}

By W. C. McGUFFIN³

INTRODUCTION

The geometrid subfamily Larentiinae is represented in the Nearctic Region by approximately 400 species assigned to 60 genera in 8 tribes. A number of the species are of economic importance. Some of these defoliate trees and ornamental shrubs and others feed on the seeds of conifers. There are also many species which may be collected in samples of foliage-feeding insects and in order to complete the records on such samples it is necessary to identify them. Information on characters for the identification of genera and species is quite scarce for the larval Larentiinae. To fill such a need the present study arose.

This study has been divided into two parts, the first to deal with the comparative external morphology and classification, and the second to serve as an identification guide and descriptive catalogue of the larval species.

PART I COMPARATIVE EXTERNAL MORPHOLOGY AND CLASSIFICATION

Although no detailed works on the morphology and taxonomy of geometrid larvae have been noted in a survey of the literature, several writers have published useful contributions to these phases of larval study. There is much helpful data in Packard's Monograph (1876) where larval characteristics for the family, subfamily, genus, and species are presented. Many of Dyar's papers published between 1894 and 1905 described the colour patterns of geometrid larvae. Knight (1941), in his doctoral thesis, presented information on the morphology of these larvae and drew up a key to separate them into subfamilies, genera, and species. This unpublished work dealt with 28 genera, 19 of which were in the subfamily Ennominae, 4 in the Larentiinae, and the other 5 divided among the Geometrinae, Sterrhinae, Oneochrominae, and Brephinae. Forbes (1948), in Part II of "Lepidoptera of New York" supplied much data on the morphology of geometrid larvae. He divided the family, on adult characters, into the six subfamilies discussed by Knight. Forbes also broke down the Larentiinae into eight tribes: Hydriomenini, Stammadini, Xanthorhoini, Asthenini, Operophterini, Eudulini, Eupitheciini, and Lobophorini. The tribal arrangements of Forbes, with the addition of an extra tribe, the Mesoleucini, is used throughout this paper. Singh (1951) studied the larvae of 46 genera of Indian Geometridae in some detail and prepared a key to the genera.

When an examination of these works of Packard, Dyar, Knight, Forbes, and Singh had been completed it was quite clear that, before a satisfactory classification of the larvae could be developed, a detailed investigation of their external morphology should be completed. With this in mind the larvae of 114 species of 32 genera of Larentiinae were collected, through loans and rearings, and studied. Many of these were observed while living but a large number were examined in the preserved state. For detailed studies of gross characters magnifications of 20 or 45 times were sufficient; other structures were magnified to about 400 times. The drawings of 20 and 45 magnifications were made with a grid micrometer eyepiece and grid-ruled paper. Each figure was drawn from a single specimen and, where possible, checked against other specimens to deter-

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mine intraspecific variation. Similar parts were drawn to approximately the same scale.

The plants referred to in this work are for the most part forest trees and shrubs. These were identified, with assistance where necessary, by the writer. The names used, both common and scientific, are those found in Gray (1950), Shoemaker (1938), Sudworth (1908), and Little (1953). Where the larvae feed on more than one species of the same genus, the generic name alone is given, as *Salix* or *Ribes*.

COMPARATIVE EXTERNAL MORPHOLOGY

Head

Head Capsule

The heads of larentiine larvae are somewhat bulbous. The cuticle may be comparatively smooth, covered with a reticulate pattern, or finely roughened with minute spicules (Figs. 89, 91, 94, 97, 100, and 102).

When seen from the front (Figs. 19-22) the head consists of two large hemispherical lobes which lie on either side of a median triangular sclerite. The median triangular sclerite has at each side an elongate, narrow plate separated from it by distinct sutures. The triangular sclerite is here considered to be the clypeus, as it was termed by Snodgrass (1935, 1947), Janse (1932), Ferris (1943), and Cook (1944). The narrow, elongate sclerite on each side of the clypeus is thought to be the visible portion of the frons or frontal area as designated by Snodgrass (1935, 1947). The suture between these will be called the clypeofrontal (Ferris, 1943). The line bounding the frons is the cleavage line (Snodgrass, 1947, and Hinton, 1948). The major portion of the head posterior to the cleavage line is known as the parietal lobes (Snodgrass, 1935, 1947). These lobes are separated, posterior to the clypeus, by the epicranial stem (coronal suture) which extends posteriorly to the membranous area known as the vertical triangle.

Among larvae of different species dissimilarities in head measurements may sometimes be expressed by comparing the head width-head length ratios, where "head width" (W) is the width of the head at its widest point and "head length" (L) is the distance from the anterior margin of the clypeus to the vertical triangle (Figs. 19 and 20).

The labrum, which is attached to the anterior margin of the clypeus by a membrane, varies in form from genus to genus (Figs. 47 - 61).

On the posterior ventral aspect of the larentiine larva there is a narrow strip of membrane separating the hypostoma (Fig. 85). This strip widens out anteriorly and, included in it, is the postmentum.

Appendages of the head

The antennae are situated near the inner articulations of the mandibles (Fig. 87). There are three segments according to Dethier (1941). Segment 1 is shorter than segment 2 and the latter is longer than wide. At the proximal end of segment 2 there is a single sensillum campaniformium. At the distal end of segment 2 there are: segment 3, two long, thick-walled hairs, the sensilla trichodea, and three sensilla basiconica. Segment 3 is much smaller than segment 2 and bears at its apex three or four sensilla. Always present are a sensillum styloconicum considered as segment 4 by Gerasimov (1952) and two sensilla basiconica, one large and one small. The antennae of larentiine larvae display relatively little variation.

The mandibles are thick triangular appendages with the double-ridged mesal surface differentiated into a distal, toothed, incisor lobe and a proximal molar

lobe (Figs. 62 - 73). The mandibles vary in shape, a character that is of use in separating the larvae into tribes.

The maxillae, the labium, and the hypopharynx are united to form a lower lip. The anterior wall of the labium apparently is joined to the hypopharynx and the duct of the silk gland opens through a tube, the spinneret, at the tip of the labium. Each maxilla includes a cardinal area, a stipital area and a free terminal lobe (Fig. 86). On this terminal lobe is a swelling which bears two papilla-like, probably sensory, structures and one slender, cylindrical segment at the end of each, and three hairs. These hairs are probably sensory in function. At the tip of the maxillary lobe are five tubercles, which are probably sensory in function also.

The membranous submental region of the labium is united on each side with the marginal ridges of the stipital area (Fig. 85). The distal part is the prementum which on its anterior surface supports the hypopharynx. At the tip of the hypopharynx are the spinneret and 2-segmented labial palpi. The spinneret may be long and slender as in the *Operophterini* (Fig. 82), the *Asthenini* and some *Hydriomenini* (Fig. 80), long and stout as in the *Xanthorhoini* (Fig. 81), short and stout as in *Thera* (Fig. 76) and *Eudule* (Fig. 79), or between these extremes (Figs. 74 - 78).

Larentiine larvae have six ocelli arranged in a semicircular fashion on each side of the head. The ocelli are designated by numbers, beginning with 1 on the upper and ending with 6 on the lower part of the semicircle (Figs. 21 and 22).

Thorax

The thorax bears three pairs of segmented appendages and on the prothorax the mesothoracic spiracle (Snodgrass, 1935). The cuticle may be smooth at low magnifications, and faintly reticulate or quite rough at high (Figs. 88, 90, 92, 93, 95, 96, 98, 99, and 101). The cuticle of each thoracic segment is folded into transverse wrinkles or annulets. There are from two to four annulets on the prothorax and from three to seven on the other thoracic segments. In the dorsal region of the prothorax there is a sclerotized area, the "prothoracic" or "cervical shield" of Packard (1895) and Crumb (1929) and "apical tergal plate" of Crampton (1918).

Appendages of the thorax

Each thoracic segment bears a pair of segmented legs, attached to the latero-ventral margin. The leg is composed of coxa, trochanter, femur, tibia, tarsus, and pretarsus. The pretarsus or claw is variable in appearance (Figs. 103 - 121) and offers characters of value in separating the larvae into tribes and smaller divisions.

Abdomen

The abdomen of the larentiine larva is composed of ten ring-like segments. Each segment is divided into annulets, these being most abundant on the second, third, and fourth segments where most of the lateral bending of the larva takes place. The larvae of some genera are quite slender (*Lygris*) but in others they are stout (*Operophtera* and *Thera*); in *Eupithecia* both types occur. The prolegs are on the sixth and tenth segments, those on the former being called the ventral and those on the latter, the anal, prolegs. The tenth segment bears on its dorsal surface the triangular anal plate or shield. There is variation in the shape and setal pattern of this shield in the Larentiinae (Figs. 198 - 213). The anal opening is situated beneath this plate. The epiproct above the opening, apparently, is part of the anal plate. Below the anal opening is the hypoproct

and to either side of the latter are the paraprocts. The paraprocts, assisted perhaps by the hypoproct, aid in the ejection of the frass pellets. The epiproct, hypoproct, and paraprocts represent what remains of the eleventh segment (Snodgrass, 1931). In some geometrid larvae the hypoproct and paraprocts are quite well-developed; this is thought by Packard (1895) to be related to adaptation for a boreal environment.

Abdominal appendages

The prolegs are hollow, cylindrical outgrowths of the body wall (Hinton, 1952, and 1955). At the distal end of each is the planta, which bears the crochets. In larrentine larvae the crochets are biordinal and arranged in either a continuous or a broken mesoseries (Figs. 208 and 209). In addition to the crochets there are a number of secondary, or additional, setae exclusive of seta V-1 on the sides of these legs. This number appears to be constant on the anal legs of the nearctic species but varies a great deal on the ventral legs; in the Indian species the number varies on both (Singh, 1951). Where the setae are numerous the legs are far apart and have several setae on the mesal aspect of each leg, in addition to the one primary seta (V-1) that is always present.

Chaetotaxy

The importance of a study of setal arrangement for the classification of caterpillars was noted in 1886 by Muller (*vide* Fracker, 1915). Since then Dyar (1894), Fracker (1915), Heinrich (1916), Forbes (1910, 1914, and 1916), Gerasimov (1935, 1937, and 1952), and Hinton (1946) have contributed works on this phase of larval study and Fracker (1915) and Hinton (1946) have presented historical and critical reviews of the contributions of others.

The system of setal classification as outlined by Hinton (1946) has been applied to geometrid larvae in this study (Tables I and II). There are roughly two kinds of setae on larrentine larvae: very small, microscopic setae and long, tactile setae. The microscopic setae usually occur on the head, thorax and abdomen where there is overlapping by adjacent body regions. The long setae are distributed over the exposed portions of the body.

The setal groups of the head are listed in Table I and illustrated in Figs. 19 - 46. The Vertical (V) and Genal (G) setae are short and cannot be seen, usually, in frontal aspects. The Vertical setae are located near the caudal margin and the Genal setae near the cephalic margin of the parietal lobes. The Clypeals: C-1, C-2, and C-3, are long setae located on the lower part of the clypeus. The Frontals (F) are usually shorter than the Clypeals; F2 is usually behind and slightly mesad of F-1. There are three Anterodorsals: A-1 is near, often above, the base of the antenna; A-2 is caudad and often laterad to A-1, and A-3 is usually laterad to A-2. The three Ocellars (O) are near the ocelli; O-1 is usually close to the third and fourth ocelli, O-2 is usually near the first ocellus, and O-3 is towards the caudal margin of the head. The three Subocellars (SO) are below the ocelli; SO-1 is near the sixth ocellus, SO-2 on or below a line between ocelli 5 and 6, and SO-3 behind and below SO-2. The lateral seta (L-1) may be near or considerably caudad to the first ocellus. There are two Posterodorsals (P); P-1, usually about midway between L-1 and F-2, is commonly the longest seta on the head and P-2 is usually caudad to P-1. There are six setae on the labrum, two on the mandibles and several on the other mouthparts. Since the labral setae vary in position they have been named. The medial ones have been named M-1, M-2, and M-3 and the outer ones, Laterals: L-1, L-2 and L-3 (Gerasimov, 1952).

TABLE I

Names of cranial setae and pores according to Heinrich, Gerasimov, Hinton, and McGuffin

| Heinrich, 1916 | | Gerasimov, 1935 | | Hinton, 1946 | McGuffin |
|---------------------|-------|--------------------|--------|--------------|----------|
| Anterodorsal | Ad-1 | Anteriores prima | A1 | A1 | A-1 |
| " | Ad-2 | " secunda | A2 | A2 | A-2 |
| " | Ad-3 | " tertia | A3 | A3 | A-3 |
| " | Ad-2a | Porus anteriores | Aa | Aa | A-a |
| Ocellar | O-3 | Ommatilis prima | O1 | O1 | O-1 |
| " | O-2 | " secunda | O2 | O2 | O-2 |
| " | O-1 | " tertia | O3 | O3 | O-3 |
| " | O-1a | Porus ommatilis | Oa | Oa | O-a |
| | | " | Ob | (not named) | |
| Subocellar | SO-1 | Subommatilis prima | SO1 | SO1 | SO-1 |
| " | SO-2 | " secunda | SO2 | SO2 | SO-2 |
| " | SO-3 | " tertia | SO3 | SO3 | SO-3 |
| " | SO-2a | Porus subommatilis | SOa | SOa | SO-a |
| | | " | SOb | (not named) | - |
| | | " | Soc | (not named) | - |
| Lateral | L-1 | Lateralis | L1 | L1 | L-1 |
| " | L-1a | Porus lateralis | La | La | L-a |
| Posterodorsal | Pd-1 | Posteriores prima | P1 | P1 | P-1 |
| " | Pd-2 | " secunda | P2 | P2 | P-2 |
| " | Pd-1a | Porus posteriores | Pa | Pa | P-a |
| " | Pd-2a | " | Pb | Pb | P-b |
| | | Verticalis prima | V1 | V1 | |
| | | " secunda | V2 | V2 | |
| | | " tertia | V3 | V3 | |
| Secondary tubercles | | Porus verticalis | Va | (-Pb) | |
| | | " | Vb | Va | |
| Genal | G-1 | Genalis | G1 | G1 | |
| | | | G2 | G2 | |
| Genal | G-1a | Porus genalis | Ga | Ga | |
| Fr.-1 | | Frontalis | F1 | F1 | C-3 |
| Fr.-a | | Porus frontalis | Fa | Fa | C-a |
| Adf. 1 | | Fronto-lat. prima | Fr.1.1 | AF1 | F-1 |
| Adf. 2 | | " secunda | Fr.1.2 | AF2 | F-2 |
| Adf. a | | Porus fronto-lat. | Fr.1.a | AFa | F-a |
| Ep. 1 | | Clypealis prima | C1.1 | C1 | C-1 |
| Ep. 2 | | " secunda | C1.2 | C2 | C-2 |

The setal groups of the thorax and abdomen have been listed in Table II and illustrated in Figs. 122-197.

Since the microscopic setae vary little if any in numbers and position throughout the order Lepidoptera (Hinton, 1946) their positions have not been indicated on all the setal maps. On the prothorax are labelled MXD-1, MV-2, and MV-3 and on the anterior edges of the mesothorax and metathorax are MD-1, MSD-1, MSD-2, MV-1, MV-2, and MV-3 (Fig. 146). The abdominal segments bear setae MD-1 and MV-3; both are on all but the tenth segment, seta MD-1 is cephalad to the Dorsal setae and seta MV-3 is cephalad to the Subventral setae.

In the XD group there are two setae confined to the prothorax. Both setae are primary, that is, they are present in all instars (Fracker, 1915).

The Dorsal group consists of two primary setae on the dorsum; both of these are found on all segments. As a general rule D-1 is more dorsad and cephalad than D-2 but on the ninth segment D-1 is usually ventrad to D-2.

The Subdorsal group is made up of two setae, both primary. SD-2 is absent from the ninth segment and quite small on the other abdominal segments. On the prothorax of some larentiine genera (*Nyctobia*, *Lobophora*, *Stammoctenis*), SD-2 is paler in colour and wider in diameter than SD-1.

TABLE II
Names of thoracic and abdominal setae according to Fracker, Gerasimov, and Hinton

| | Fracker | | Gerasimov | | Hinton | |
|-------------------|---------|----------|------------|--------|---------------|------|
| | Jugatae | Frenatae | Hepialidae | Others | | |
| Thorax I | Gamma | Alpha | IX | X | Tactile | XD1 |
| | Epsilon | Gamma | IIIa | IX | " | XD2 |
| | Alpha | Beta | X | I | " | D1 |
| | Beta | Delta | I | II | " | D2 |
| | Rho | Epsilon | II | IIIa | " | SD1 |
| | Delta | Rho | III | III | " | SD2 |
| | Eta | Kappa | V | IV | " | L1 |
| | Kappa | Eta | IV | V | " | L2 |
| | Theta | Theta | VI | VI | " | L3 |
| | Pi | Pi | VIIa | VIIa | " | SV1 |
| | Nu | Nu | VIIb | VIIb | " | SV2 |
| | Sigma | Sigma | VIII | VIII | " | VI |
| | - | - | - | Xa | Proprioceptor | MXD1 |
| | Tau | - | VIIc | VIIc | " | MV2 |
| | Phi | - | VIIId | VIIId | " | MV3 |
| Thorax II and III | Alpha | Alpha | I | I | Tactile | D1 |
| | Beta | Beta | II | II | " | D2 |
| | Rho | Rho | III | III | " | SD1 |
| | Delta | Epsilon | IIIa | IIIa | " | SD2 |
| | Kappa | Kappa | V | IV | " | L1 |
| | Epsilon | Eta | IV | V | " | L2 |
| | Theta | Theta | VI | VI | " | L3 |
| | Pi | Pi | VIIa | VIIa | " | SV1 |
| | - | Nu | - | - | " | SV2 |
| | Sigma | Sigma | VIII | VIII | " | VI |
| | Gamma | - | Xa | Xa | Proprioceptor | MD1 |
| | - | - | - | Xb | " | MD2 |
| | Gamma | - | IXa | IXa | " | MSD1 |
| | Gamma | - | IXb | IXb | " | MSD2 |
| | Nu | - | VIIb | VIIb | " | MV1 |
| | Tau | - | VIIc | VIIc | " | MV2 |
| | Omega | Omega | VIIId | VIIId | " | MV3 |
| Abdomen 1-9 | Alpha | Alpha | I | I | Tactile | D1 |
| | Beta | Beta | II | II | " | D2 |
| | Rho | Rho | III | III | " | SD1 |
| | Epsilon | Epsilon | IIIa | IIIa | " | SD2 |
| | Theta | Kappa | IV | IV | " | L1 |
| | Kappa | Eta | V | V | " | L2 |
| | Eta | Mu | VI | VI | " | L3 |
| | - | Lambda | - | VIa | " | - |
| | Pi | Pi | VIIa | VIIa | " | SV1 |
| | Nu | Nu | VIIb | VIIb | " | SV2 |
| | Tau | Tau | VIIc | VIIc | " | SV3 |
| | Sigma | Sigma | VIII | VIII | " | VI |
| | - | - | X | Xa | Proprioceptor | MD1 |
| | - | - | - | Xb | " | MD2 |
| | Omega | - | VIIId | VIIId | " | MV3 |

In the Lateral group there may be four setae. Of these L-1 is nearly always the longest on the thoracic segments and L-3 on the abdominal segments (Hinton, 1946). The others are often of about equal length. The first Lateral seta is caudad to the spiracle on the abdomen and its exact position varies from genus to genus. The seta, L-2, is either anteroventrad or ventrad to the spiracle. Seta L-3 is below L-1 and usually below L-2. Seta L-4 is not present in the first instar; it is located mesad of L-3. On the ninth abdominal segment the Lateral setae are arranged in a vertical line. On the prothorax L-2 is similar to SD-2 in size and shape.

Three setae make up the Subventral group. There are two SV setae on the prothorax but only one on the other thoracic segments. On the abdominal segments also the number of SV setae varies. On the first segment there are two SV setae in some genera (*Venusia*, *Hydrelia*, *Rheumaptera*, *Coryphista*, and *Calocalpe*) (Figs. 124 and 125) and three in the others (Figs. 147, 150, and 151). There are three such setae on abdominal segments two to five inclusive, a variable number on segments six and ten, two each on segments seven and eight and one only on segment nine. The long primary seta is SV-1 and the shorter seta, which is usually anteromesad from it, is SV-2. The subprimary SV-3, (as it is not present in the first instar) is always distinctly shorter than SV-1 and often shorter than SV-2; this seta is usually posterior to and somewhat dorsad from SV-1.

The single seta in the Ventral group, V-1, is near the midventral line of all thoracic and abdominal segments. It is always nearer the midventral line than any of the Subventral group, and on the leg-bearing segments it is often on the mesal side of the leg.

On the anal shield there are four setae to which the names D-1, D-2, SD-1 and L-1 have been assigned. There is some variation at the generic level in the arrangement of these setae (Figs. 198 - 213).

CLASSIFICATION

The larvae of the Geometridae possess two pairs of prolegs, one on the sixth and one on the tenth, abdominal segments. In two nearctic genera there is an extra vestigial pair on the fifth abdominal segment (*Alsophila* and *Campaea*); the Brepinae have three extra pairs, all incompletely developed, on the third, fourth, and fifth abdominal segments. Other characteristics of the family are: the presence of primary setae only above the level of the spiracle; crochets biordinal and arranged in a mesoseries (Figs. 214 and 215); vertex of the head almost rounded or moderately to strongly bifid; body usually almost cylindrical, sometimes quite slender but at others bearing protuberances of various kinds and shapes.

Key to the Subfamilies of Mature Geometrid Larvae

1. Seta L-4 present on the abdominal segments 2, 3, 4 and 5 (Figs. 135, 137 and 138); body with or without tubercles, ridges, or protuberances..... 4
 Seta L-4 absent from abdominal segments 2, 3, 4 and 5 (Figs. 133, 136, and 139-195); body without ridges and tubercles (lateral thoracic protuberances on some species of *Lygris*)..... 2
2. Larvae with vestigial prolegs on segment 5..... 3
 Larvae without vestigial prolegs on segment 5..... *Larentiinae*
3. Larvae with vestigial prolegs on segment 5 only..... *Oenochrominae*
 Larvae with vestigial prolegs on segments 3, 4 and 5..... *Brepinae*
4. Anal plate with setae D-1 and SD-1 approximately in a transverse row as in *Xanthorhoe* (Fig. 201); first five abdominal segments each with from 8 to 20 annulets; abdominal segment 1 with a total of six or seven long setae in the L, SV, and V groups on each side (Figs. 129 and 130); small larvae, less than 30 mm. in length..... *Sterrhinae*
 Anal plate with setae D-1 considerably posterior to line between setae SD-1, as in *Horisme* (Fig. 210); first five abdominal segments each with from 4 to 8, occasionally more, annulets; abdominal segment 1 always with a total of seven long setae in L, SV and V groups on each side (Figs. 128, 131 and 132); larvae large or small..... 5
5. Setae SV-1, SV-2 and V-1 in, or almost in, a transverse line on first abdominal segment (Fig. 131); larvae often large in size, if cuticle rough..... *Ennominae*
 Setae SV-1, SV-2 and V-1 not in a transverse line on the first abdominal segment (Fig. 132); larvae small, less than 30 mm. in length; cuticle rough..... *Geometrinae*

Larvae of the Subfamilies of Nearctic Geometridae

Brepbinae

There are, at present, two genera in this subfamily. Each genus is represented by a single species, *Brepbos infans* Moesch., described by Brainard (1897) and *Leucobrepbos brephoides* Wlk., described by Gibson and Criddle (1916). The larvae are striped in green with pale contrasting lines.

Oenochrominae

The Fall Cankerworm, *Alsophila pometaria* Harr., is the only widely distributed member of this subfamily. The larvae are striped in green or brown, with pale contrasting lines (Porter and Alden, 1924).

Geometrinae (Hemitheinae of Forbes, 1948 and Singh, 1951).

McDunnough (1938) lists 17 genera in this subfamily. The larvae vary so much in appearance that no attempt will be made at a summary of the colour patterns. Descriptive accounts of these may be found in Dyar (1899a, 1900c, and 1901c); Comstock (1945), Comstock and Dammers (1934 and 1937), Comstock and Henne (1940), and Dethier (1942).

Sterrbinae

There are 20 genera in this subfamily (McDunnough, 1938). The larvae are coloured in various shades of brown. Several species have been described by Dyar (1899-1905) and Dethier (1942).

Ennominae

This is the largest subfamily in the Geometridae. In it there are 140 genera (McDunnough, 1938). Descriptions of the larval patterns, which are variable, may be found in Packard (1876, 1890), Dyar (in Psyche, 1899-1905), Comstock (in the Bulletin of the Southern California Academy of Sciences, 1927-1945), Dethier (1942), Forbes (1948), Rindge (1949), and McGuffin (in the Canadian Entomologist, 1943-1956).

Larentiinae

Representatives of the 32 nearctic genera of the subfamily display great variation when the specialized genera are considered but are vexingly similar when the generalized ones are examined. In the keys that follow use has been made of the variable characters to separate the tribes, subtribes, and genera of Part I and the species of Part II. A large number of descriptions of these larvae have been published; to these reference is made in Part II.

Key to the Tribes of Mature Larentiine Larvae

1. Larvae with a total of six setae in the L, SV, and V groups of abdominal segment 1 (Figs. 124 and 125)..... 2
 Larvae with a total of seven setae in the L, SV, and V groups of abdominal segment 1 (Figs. 123, 126, and 127)..... 4
2. Spinneret much longer than labial palpi (Fig. 82); thoracic claw almost straight, with angle of notch acute (Figs. 103 and 104)..... *Asthenini*
 Spinneret shorter, or but little longer than labial palpi (Figs. 79 and 83); thoracic claw curved, with angle varying from acute to obtuse (Figs. 106 and 120)..... 3
3. Larvae long and slender; anterior abdominal segments with 12 or more annulets; setae of third abdominal segment widely scattered (Fig. 187); cuticle of head very rough (Fig. 102); spinneret shorter than labial palpi (Fig. 79); seta M-3 of labrum on line between setae M-1 and L-3 (Fig. 56); molar lobe of mandible bulging (Fig. 69), notch of thoracic claw quite obtuse (Fig. 120); crochets on ventral proleg number about 10 in two groups..... *Eudulini*
 Larvae stout; anterior abdominal segments with less than 8 annulets; setae of third abdominal segment in two lines (Figs. 141 and 142); cuticle of head smooth or faintly reticulate; spinneret longer than labial palpi; seta M-3 of labrum not on line from seta M-3 to seta L-3 (Fig. 53); molar lobe of mandible almost flat (Fig. 71); notch of thoracic claw acute or rounded (Figs. 105 and 106); crochets

- on ventral proleg number 20 to 34, in one group (*Coryphista*, *Calocalpe*, *Rheumaptera*) Hydriomenini
4. Secondary setae on side of ventral proleg number six or less 5
- Secondary setae on side of ventral proleg number eight or more 9
5. Setae D-1 on anal plate anterior to line joining setae SD-1 (Figs. 206, 207, and 212) 6
- Setae D-1 on anal plate posterior to line joining setae SD-1 (Figs. 208, 211 and 213) 7
6. Cuticle of body almost smooth (Fig. 99); larvae green with pale lines (Figs. 7 and 9) Lobophorini
- Cuticle of body noticeably rough (Figs. 95 and 96); larvae may be green or patterned in other colours (Figs. 1-4, 6, 173-190, and 195) (*Eupithecia*) Eupitheciini
7. Spinneret extends well beyond labial palpi (Fig. 82) Operophterini
- Spinneret does not extend beyond labial palpi (Figs. 75 and 76) 8
8. Secondary setae on side of ventral proleg number 4; host plants are *Clematis* and *Atragene* (*Horisme*) Eupitheciini
- Secondary setae on side of ventral proleg number 5 or 6; host plants many, with *Clematis* and *Atragene* excluded Hydriomenini
9. Hypopharynx with labial palpi set well back from spinneret (Fig. 84); cranial seta L-1 considerably out of alignment with setae A-2 and A-3 (Fig. 34); body setae short and fine (Fig. 156) Stannodini
- Hypopharynx with labial palpi set even with or close behind the spinneret (Figs. 80, 81, and 83); cranial seta L-1 in or almost in alignment with setae A-2 and A-3 (Figs. 21, 30, 31, 33, 35-38); body setae stout, long (Figs. 139-145 and 155-160) 10
10. Spinneret extends much beyond tips of labial palpi (Fig. 80) Mesoleucini
- Spinneret extends little beyond tips of labial palpi (Figs. 81 and 83) 11
11. Eight to ten secondary setae on side of ventral proleg; crochets on ventral proleg number 12-36 Xanthorhoini
- Twelve to 18 secondary setae on side of ventral proleg; crochets on ventral proleg number 30-60 (*Hydriomena*) Hydriomenini

Tribes and Genera of the Larentiinae

Asthenini

The larvae of the Asthenini, represented here by *Hydrelia* Hübner and *Venusia* Curtis, are green in colour; there may be rose-coloured dorsal markings on *Venusia*. The larvae vary from about 10 mm. in length in *Hydrelia* to as much as 20 mm. in *Venusia*. The spinneret is much longer than the labial palpi. The setae are long, brown, and pointed. Seta A-3 on the head is on a line drawn between setae L-1 and A-2 (Figs. 24 and 25). The thoracic claws are slightly curved, with an acute angle at the notch (Fig. 103). There are four annulets on the third abdominal segment. The hypoproct and paraprocts are small. The crochets of the ventral proleg number from 16 to 18, in two groups, and there are four or five secondary setae on the side of this leg. There are six setae in the L, SV and V groups of the first abdominal segment (Fig. 124), and on the third abdominal segment, the setae are in two lines (Figs. 146 and 147). Setae D-1 of the anal plate are posterior to a line drawn between setae SD-1 (Fig. 199).

The dissimilarity in size of larvae of *Venusia* and *Hydrelia* is used to distinguish the genera of this tribe. Size is not a very satisfactory character for this but the absence of more conspicuous morphological differences may indicate that the genera are closely related.

Key to Genera (Mature Larvae)

- Head width varies from 1.00 to 1.17 mm.; total larval length varies from 9 to 10 mm. *Hydrelia*
- Head width varies from 1.19 to 1.45 mm.; total larval length varies from 12 to 18 mm. *Venusia*

Hydrelia Hübner

The larvae of *H. albifera* Wlk. are green; some specimens have a dark spot on the upper part of each parietal lobe; there may be pale lines on the thorax

and abdomen. These larvae feed on dogwood (*Cornus*) in late July and early August.

Venusia Curtis

The larvae of *V. pearsalli* Dyar, *V. cambrica* Curt. and *V. comptaria* Wlk. are green; in *V. cambrica*, there may be rose-coloured markings on the dorsum. One host-plant, alder (*Alnus*) is common to all three species. The larvae of *V. pearsalli* and *V. comptaria* feed in spring and early summer and *V. cambrica* feeds in late summer. The life history of *V. pearsalli* has been determined; in this species there are three larval instars; head capsule measurements indicate three larval instars for *V. comptaria* also. In no other genus of the Larentiinae of which the larval history is known, are there fewer than four instars.

Xanthorhoini

These larvae, as shown by a number of species examined in the genera *Epirrhoe* Hübner, *Zenopbleps* Hulst, *Camptogramma* Stephens, *Percnophilota* Hulst, and *Xanthorböe* Hübner, are oblong in shape and pale brown or green in colour (Figs. 8, 155, and 157-160). They may be small, about 13 mm. in length, or moderate, about 30 mm. The cuticle is rough. The depth of the labral notch is about one-third the width of the labrum (Figs. 59 and 61). The molar lobe of the mandibles has a bulge (Figs. 67 and 72). The spinneret projects slightly beyond the labial palpi (Fig. 81). The thoracic claws are broadly rounded (Figs. 107, 108, 110, 113 and 115). The setae are pointed and of varying lengths. Seta A-3 of the head is on or almost on the line drawn between setae L-1 and A-2 (Figs. 31-33 and 35-38). There are three SV setae on the first abdominal segment (Fig. 123). Setae SV-3, SV-1 and V-1 are in line, or almost in line, on the third abdominal segment (Figs. 150, 153, 155, 157-160). There are from four to seven annulets on the third abdominal segment. The hypoproct and paraprocts are small. The crochets of the ventral proleg number from 11 to 36 and the setae on the side of this leg number from eight to ten. On the anal plate setae D-1 are always on, or posterior to, the line drawn between setae SD-1 (Figs. 201-203).

Key to Genera (Mature Larvae)

1. Larvae with dark dorsal markings in the form of diamonds, crosses, or arrows..... 2
Larvae with simple longitudinal lines on dorsum (Fig. 8)..... 5
2. Crochets of ventral proleg number 12 to 26; larvae on plants other than *Galium*..... 3
Crochets of ventral proleg number 27-34; larvae on *Galium*..... *Epirrhoe*
3. Larvae on *Picea* and *Pinus*..... *Zenopbleps*
Larvae on angiosperm plants..... 4
4. Width of head varies from 1.54 to 1.90 mm.; larvae feed on *Pisonia*..... *Camptogramma*
Width of head varies from 1.30 to 1.52 mm.; larvae feed on herbs of many kinds
Xanthorböe
5. Width of head varies from 1.00 to 1.39 mm.; larvae feed on *Polygonum* and *Rumex*
Percnophilota
Width of head varies from 1.54 to 1.78 mm.; larvae feed on *Galium*..... *Epirrhoe*

Epirrhoe Hübner

In *E. alternata* Mull., and *E. speyeri* Herb. the larvae are pale grey with brown lines (Figs. 8 and 160). They feed on *Galium* in midsummer and early autumn.

Xanthorböe Hübner

In the five species examined: *X. packardata* McD., *X. emendata* Pears., *X. lacustrata* Gn., *X. munitata convallaria* Gn., and *X. ferrugata* Clerck form *undentaria* Haw., the larvae are brown. The head is marked with dark streaks or lines in herring-bone pattern and the abdomen is patterned with dark crosses.

diamond-shaped patches, or pale arrow-like designs (Fig. 159). The food plants are herbs of many kinds: *Alyssum*, *Impatiens*, *Polygonum*, *Epilobium*, *Senecio*, *Taraxacum*, and *Glechoma*.

***Camptogramma* Stephens**

Larvae of *C. stellata* Gn. are grey with brown markings on the head, thorax, and abdomen. The host-plant is *Pisonia*.

***Percnoptilota* Hulst**

These larvae may be green or reddish-brown and often have dark markings on the head, thorax and abdomen (Fig. 158). In the one species studied, *P. obstipata* Fabr., the host-plants are *Polygonum* and *Rumex*.

***Zenophleps* Hulst**

The larva of *Z. lignicolorata* Pack. is pale grey with grey markings on head, thorax and abdomen (Fig. 155). The length of the larva is about 18 mm. It feeds on limber pine (*Pinus flexilis* James) and Engelmann spruce (*Picea engelmannii* Parry).

Stannodini

The larvae of one species, *Stannoctenis morrisata* Hlst., (the only one examined in this tribe) are oblong in shape and green in colour (Fig. 156). They are about 13 mm. in length. The cuticle is rough. The notch of the labrum is broadly rounded (Fig. 57). The mandibles are much like those of the Xanthorhoini. The spinneret is long and slender (Fig. 84). The thoracic claw is similar to that of the Xanthorhoini (Figs. 110, 115, 116, and 117). There are four annulets on the third abdominal segment. The setae are generally short and fine but some are of moderate length and flattened at the tips (SD-2 and L-2 on the prothorax). Seta A-3 of the head is posterior to the line drawn between setae L-1 and A-2 (Fig. 34). The setal arrangement of the third abdominal segment (Fig. 156) is similar to that of some of the Xanthorhoini. There are between 16 and 21 crochets on the ventral proleg and 11 secondary setae on the side of this leg. Setae D-1 of the anal plate are posterior to a line between setae SD-1 (Fig. 205). The hypoproct and paraprocts are small.

The larvae feed in late summer on Rocky Mountain Juniper (*Juniperus scopulorum* Sarg.).

Operophterini

There are two North American genera, *Epirrita* Hübner and *Operophtera* Hübner, in this tribe. The larvae are oblong in shape and green, yellow-green, or grey-green, with white or yellow lines (Figs. 16 and 17). They vary from 15 to 25 mm. in length. The cuticle is smooth or faintly reticulate. The lateral setae on the labrum are in line (Figs. 54 and 55). The mandibles are much like those of the Hydriomenini (Figs. 63, 65 and 66). The spinneret is longer than the labial palpi (Fig. 82). The setae are long and pointed. On the head (Fig. 23) seta A-3 is on the line between setae L-1 and A-2. The notch of the thoracic claw is acute (Fig. 104). There are four annulets on the third abdominal segment. The hypoproct and paraprocts are small. On the ventral proleg, the crochets number 18 to 35 in one group and there are four secondary setae on the side of this leg. On the third abdominal segment the setae are in two lines (Figs. 148 and 151). There are four setae occasionally in the L group on the third segment of *Epirrita*; this phenomenon has never been observed on both sides of the same larva. Setae D-1 of the anal plate are posterior to a line drawn between setae SD-1 (Fig. 198).

Key to Genera (Mature Larvae)

| | |
|-----------------------------------|--------------------|
| Width of head 1.34 - 1.52 mm..... | <i>Operophtera</i> |
| Width of head 1.70 - 2.30 mm..... | <i>Epirrita</i> |

Operophtera Hübner

In both *O. bruceata* Hlst. and *O. brumata* L., there are green and grey-green larvae (Fig. 16). The larvae feed on angiosperm trees and shrubs in the spring and early summer. *O. brumata* is one of the few larentine species known to have five larval instars.

Epirrita Hübner

The larvae of *E. autumnata omissa* Harr. are green or yellow-green (Fig. 17). They feed in early summer on spruce (*Picea*), Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco), alpine fir (*Abies lasiocarpa* (Hook.) Nutt.), hemlock (*Tsuga*), alder (*Alnus*); trembling aspen (*Populus tremuloides* Michx.), willow (*Salix*), and blueberry (*Vaccinium*).

Mesoleucini

The writer has erected the tribe, Mesoleucini, to contain the genera *Earophila*, *Mesoleuca*, and *Spargania*. These larvae are elongate in shape, either green with pale lines, or pale brown with brown diagonal markings (Fig. 18). The length varies from 18 to 30 mm. The cuticle may be smooth, or rugulose. The Lateral setae of the labra are not in line and the mandibles are much like those of the Hydriomenini (Figs. 63, 65, and 66). The spinneret is longer than the labial palpi (Fig. 80). The setae are long and pointed. On the head (Figs. 30, 31, and 33) seta A-3 is on the line between setae L-1 and A-2. The notch of the thoracic claw is acute (Figs. 107 and 108). There are from four to six annulets on the third abdominal segment. The hypoproct and paraprocts are small. On the ventral proleg the crochets number from 11 to 24, in one or two groups, and the secondary setae on this leg number from 8 to 14. The setae of the third abdominal segment may be in two lines (Fig. 153) or the setae of the Lateral group may be out of such alignments (Figs. 149 and 150). Setae D-1 of the anal plate are posterior to a line drawn between setae SD-1.

It may, or may not be significant that the host plants of these larvae, *Rubus* and *Epilobium*, are fire-succession plants in the Boreal Forest Region.

Key to Genera (Mature Larvae)

1. Secondary setae on ventral proleg number from 8 to 10; larvae feed in June on *Rubus*.....*Earophila*
Secondary setae on ventral proleg number from 12 to 14; larvae feed from early July until early September on *Rubus*, *Epilobium*, or *Oenothera*.....2
2. Setae of third abdominal segment in two lines (Fig. 153); larvae feed on *Rubus*.....*Mesoleuca*
Setae of third abdominal segment not in two lines (Fig. 149); larvae feed on *Epilobium* and *Oenothera*.....*Spargania*

Earophila Gumpenberg

The larvae of *E. vasiliata* Gn. are green in colour, and from 20 to 30 mm. in length. They feed on *Rubus* in June.

Mesoleuca Hübner

Two species: *M. gratulata* Wlk. and *M. ruficillata* Gn., have been examined. The larvae are green, with brown triangular dorsal areas in *M. ruficillata*. They vary in length from 20 to 28 mm. The host plant is *Rubus*, on which the larvae feed from early July until early September.

Spargania Guenée

The larvae of *S. magnoliata* Gn. are green but those of *S. luctuata obductata* Moesch. may be green or brown (Fig. 18). In length they vary from 18 to 30 mm. The larvae feed in August and September on *Epilobium* and *Oenothera*.

Hydriomenini

At least 14 North American genera can be assigned to the tribe Hydriomenini. These are *Calocalpe* Hübner, *Coryphista* Hulst, *Rheumaptera* Hübner, *Triphosa* Stephens, *Hydriomena* Hübner, *Euphyia* Hübner, *Diactinia* Warren, *Eustroma* Hübner, *Lygris* Hübner, *Ceratodalia* Packard, *Trichodezia* Warren, *Plemyria* Hübner, *Dysstroma* Hübner and *Thera* Stephens. There is much variation among these but all have at least three of the four characters that are common to the larvae of this tribe. These four characters are: the presence of from four to six setae on the ventral proleg, the molar lobe of the mandible with little or no bulge (Figs. 63, 65, and 71), lines drawn from seta M-1 and M-3 to setae M-2 of the labrum usually forming a right angle at seta M-2 (Figs. 49-53), and seta A-3 of the head on or almost on the line drawn from seta L-1 to seta A-2 (Figs. 21 and 26-30). The last character does not hold for *Thera* (Fig. 19).

The genera may be divided into two subtribes. The first subtribe contains *Calocalpe*, *Coryphista*, and *Rheumaptera*. Along with these three it is convenient to consider *Triphosa* and *Hydriomena*. The larvae are oblong in shape (Figs. 11, 13, 14 and 15). They may be green, grey, or brown, with plain lines or patterned with rectangular areas (Figs. 13, 14, 15 and 139-145). The cuticle is smooth or almost smooth (Fig. 88). The spinneret is as long as, or longer than, the labial palpi (Fig. 83). The setae are long, brown, and pointed. The notch of the thoracic claw varies from acute to rounded (Figs. 105 and 106). There are from four to six annulets on the third abdominal segment. The hypoproct and paraprocts are small. The crochets of the ventral proleg number from 14 to 60, in one group. There are four secondary setae on the side of the ventral proleg in all genera but *Hydriomena*; in this there are from 12 to 18 of these setae. There are two SV setae on the first abdominal segment of *Calocalpe*, *Coryphista*, and *Rheumaptera*, and three SV setae on the first abdominal segment of *Triphosa* and *Hydriomena*. The setae of the third abdominal segment tend to fall into two lines (Figs. 139-145, 152 and 154). On the anal plate setae D-1 are posterior to a line drawn between setae SD-1 (Fig. 199).

The second subtribe contains *Euphyia*, *Diactinia*, *Eustroma*, *Lygris*, *Ceratodalia*, *Trichodezia*, *Plemyria*, *Dysstroma* and *Thera*. The larvae of the first six genera are very variable in their brown and green colour patterns but the larvae of *Plemyria*, *Dysstroma* and *Thera* are green, with white or yellow and, occasionally, rose-coloured lines on the thorax and abdomen (Figs. 10, 12, 161-166 and 194). The cuticle is rough (Figs. 89-94 and 100). The spinneret is short and stout (Figs. 75 and 76). The setae may be short or moderately long, pointed or rounded at the tips. The thoracic claws are broadly curved (Figs. 109 and 111-114). With the exception of *Diactinia*, which has eight or nine annulets, there are from four to six annulets on the third abdominal segments. The paraprocts are usually conspicuous, particularly in *Plemyria*, *Thera* and *Dysstroma* (Figs. 208, 211, and 213). The crochets of the ventral proleg number from 6 to 18, in two groups. The setae on the side of this leg number from four to six. There are always three SV setae on the first abdominal segment. The setae of the third abdominal segment are arranged in various patterns (Figs. 161-172). Setae D-1 of the anal plate are posterior to or on a line drawn between setae SD-1 (Figs. 208, 209, 211, and 213). *Thera* has from two to four more setae on the anal plate than any other larentiine (Fig. 211).

Key to Genera (Mature Larvae)

- | | |
|--|---|
| 1. Six setae in the L, SV, and V groups of the first abdominal segment | 2 |
| Seven setae in the L, SV, and V groups of the first abdominal segment | 4 |

- | | |
|---|--------------------|
| 2. W/L ratio varies from 1.39 to 1.48..... | <i>Rheumaptera</i> |
| W/L ratio varies from 1.55 to 1.82..... | 3 |
| 3. Midventral line concolorous with venter..... | <i>Calocalpe</i> |
| Midventral line pale, in contrast to dark venter..... | <i>Coryphista</i> |
| 4. Setae on side of ventral proleg number 12 to 18..... | <i>Hydriomena</i> |
| Setae on side of ventral proleg number 4 to 10..... | 5 |
| 5. Four setae on side of ventral proleg; larvae green with pale lines..... | <i>Triphosa</i> |
| Five to ten setae on side of ventral proleg; larvae green, or brown, or both..... | 6 |
| 6. Paraprocts long with lobes (Figs. 202, 205 and 207); larvae green with pale lines on dorsum and sides..... | 7 |
| Paraprocts short, without lobes; larvae green or brown..... | 9 |
| 7. Eight moderately long setae on anal plate (Figs. 12, 208, and 213)..... | 8 |
| Ten or more short setae on anal plate (Figs. 10 and 211)..... | <i>Tbera</i> |
| 8. Paraprocts as long as anal plate (Fig. 208)..... | <i>Plemyria</i> |
| Paraprocts never more than half as long as anal plate (Fig. 213)..... | <i>Dysstroma</i> |
| 9. Crochets of ventral proleg number 10-15..... | 11 |
| Crochets of ventral proleg number 16-30..... | 10 |
| 10. Larvae with midventral line dark in part; no intersegmental obliques in lateral region (Figs. 162-166)..... | <i>Lygris</i> |
| Larvae with pale midventral line; prominent intersegmental obliques in lateral region (Fig. 188)..... | <i>Ceratotalia</i> |
| 11. Larvae green with dark middorsal line present for part of length of abdomen..... | 12 |
| Larvae green or brown with no dark middorsal line..... | 13 |
| 12. Five setae on side of ventral proleg; six annulets on third abdominal segment..... | <i>Euphyia</i> |
| Six setae on side of ventral proleg; eight or nine annulets on third abdominal segment..... | <i>Diactinia</i> |
| 13. Head with dark bar across upper parietals; length of larva less than 20 mm..... | <i>Trichodezia</i> |
| Head with no dark bar across upper parietals; length of larva greater than 20 mm..... | <i>Eustroma</i> |

Calocalpe Hübner

The larvae of *C. undulata* L. and *C. prunivorata* Ferg. are patterned in contrasting pale and dark lines on thorax and abdomen (Fig. 141). The colour of the head varies from reddish-orange to brown. These larvae are about 20 mm. in length. They feed in late summer and fall on *Salix*, *Populus*, *Rhododendron*, *Spiraea*, *Azalea*, and *Prunus serotina* Ehrh.

Coryphista Hulst

The species, *C. meadi* Pack., has larvae with orange-coloured heads and striped bodies; there are five purplish-black or dark brown lines on the dorsum (Fig. 142). The length varies from 20 to 26 mm. They feed on barberry (*Berberis*) in the summer.

Rheumaptera Hübner

The brown-headed larvae of this genus have brown or black bodies; there may be four, fine, pale lines on the dorsum or pale markings in the spiracular region. The larvae vary from 14 to 20 mm. in length. They feed in late summer on alder (*Alnus*), willow (*Salix*), birch (*Betula*), aspen (*Populus tremuloides* Michx.), and *Myrica*.

Triphosa Stephens

The larva of *T. haesitata* Gn. is green, with white lines on the body. It is from 20 to 25 mm. in length. The host plants are *Rhamnus* and *Prunus* on which the larvae feed in the summer.

Hydriomena Hübner

Six species of *Hydriomena* have been examined: *H. furcata* Borg., *H. nubilofasciata* Pack., *H. renunciata* Wlk., *H. albimontanata* McD., *H. divisaria* Wlk., and *H. macdunnoughi* Swett.

The larvae are brown or grey (Figs. 13-15 and 139, 140, 143-145) and vary from 12 to 20 mm. in length. Larvae of *H. furcata* and *H. nubilofasciata* feed

on buds and young leaves of, for the former, *Salix* and *Alnus* and for the latter, *Quercus garryana* Dougl. In late summer *H. divisaria* and *H. albimontanata* feed on the foliage of conifers; *H. renunciata* feeds on *Alnus* and *H. macdunnoughi* on *Salix*.

Euphyia Hübner

The larva of *E. multiferata* Wlk. is green with a brown dorsal stripe on the thorax and abdomen. It is about 20 mm. in length. The host plant is fireweed (*Epilobium*) on which the larvae feed in late summer.

Diactinia Warren

The larvae of *D. silaceata albolineata* Pack. are yellow or pink with green markings. The length of these larvae varies from 24 to 31 mm. They feed on *Epilobium* in late summer.

Eustroma Hübner

The grey or brown larvae of *E. semiatrata* Hlst. are from 24 to 28 mm. in length. They feed on *Epilobium*.

Lygris Hübner

An examination of seven species of *Lygris*: *L. diversilineata* Hbn., *L. gracilineata* Gn., *L. propulsata* Wlk., *L. testata* L., *L. destinata* Moesch., *L. xyliua* Hlst. and *L. flavibrunneata* McD., reveals that these larvae may be green or brown; they are slender, 16 to 38 mm. in length, and feed on a number of hosts in late spring and early summer. The hosts are *Vitis*, *Ribes*, *Salix*, *Populus*, *Vaccinium*, *Potentilla*, *Rosa*, *Alnus*, and *Symphoricarpos*.

Ceratodalia Packard

The larva of *C. gueneata* Pack. is pale brown with brown markings on the head, thorax and abdomen. It is about 22 mm. in length. The food plant may be *Polygonum*.

Trichodezia Warren

The larvae of *T. albovittata* Gn. are small, 8 to 18 mm. in length, and green in colour. A brown band crosses the parietals at the apex of the clypeus. They feed on *Epilobium*, *Thalictrum*, and *Impatiens* in late summer.

Plemyria Hübner

This larva, *P. georgii* Hlst., has long paraprotecs; it is green in colour and may have a rose-coloured subspiracular line. The length varies from 18 to 23 mm. The larvae feed from the middle of June until early August on willow, alder, dogwood, and birch.

Dysstroma Hübner

The larvae of five species have been examined: *D. walkerata* Pears., *D. citrata* L., *D. ethela* var., *D. hersiliata* var. and *D. formosa* Hlst. form *boreata* Tayl. They are green with pale lines on the thorax and abdomen (Fig. 12). The paraprotecs are of moderate length (Fig. 213). The total length of the larvae varies from 13 to 28 mm. Most species feed in June and early July but one, *D. walkerata*, hibernates in the larval stage. The host plants are larch (*Larix*), gooseberry (*Ribes*), willow (*Salix*), and alder (*Alnus*).

Thera Stephens

Larvae of *T. otisi* Dyar, *T. contracta* Pack., and *T. juniperata* Pack. resemble one another in pattern and size. They are green, with white or yellow lines on the thorax and abdomen (Fig. 10). In some specimens there is a fine rose-coloured subspiracular line. The total length varies from 11 to 18 mm. The larvae feed in early summer on common juniper (*Juniperus communis* L.)

Eupitheciini

The larvae of this tribe may be long and slender, as in *Horisme*, short and stout as in some of the grub-like, seed-eating *Eupithecia*, or between these extremes (Figs. 1-6). Some are green and others have patterns of grey, brown, or black (Figs. 173-190 and 195). There are a number of characters which, taken together, serve to distinguish this tribe. The mandibles are slender (Figs. 68 and 70). The hypopharynx is tomentose whereas in most other larentiines it is smooth. The tip of the spinneret does not extend out to the tips of the labial palpi (Figs. 74 and 77). The thoracic claws are slightly curved (Figs. 118 and 119). There are from four to eight annulets on the third abdominal segment. The setae are short (less than 0.4 mm. in length) with pointed or blunt tips. On the head, seta A-3 is anterior to a line drawn between setae A-2 and L-1 (Figs. 45 and 46). The setae are scattered on the third abdominal segment (Figs. 171 and 173-184). Setae D-1 of the anal plate are anterior to a line drawn between setae SD-1 in *Eupithecia* (Fig. 212) but posterior in *Horisme* (Fig. 210). The hypoprocts and paraprocts are well-developed (Fig. 212). The crochets of the ventral proleg number from 8 to 26, in two groups, and the setae on the side of this leg number four.

Key to Genera (Mature Larvae)

- | | |
|---|-------------------|
| Setae D-1 on anal plate posterior to line drawn between setae SD-1 (Fig. 210); width of the head 1.71 to 1.90 mm.; length of larva 22 to 33 mm. | <i>Horisme</i> |
| Setae D-1 on anal plate anterior to line drawn between setae SD-1 (Fig. 212); width of head 0.90 to 1.60 mm.; length of larva 10 to 22 mm. | <i>Eupithecia</i> |

Horisme Hübner

The larvae of *H. intestinata* Gn. are pale grey with brown lines (Figs. 5 and 171) and from 22 to 33 mm. in length. They feed in late July and early August on *Atragene*.

Eupithecia Curtis

In this world-wide genus there are 140 nearctic species. The larvae of 33 species have been studied. These are:

- | | |
|-------------------------------|--------------------------------|
| <i>E. misturata</i> Hlst. | <i>E. gibsonata</i> Tayl. |
| <i>E. bryanti</i> Tayl. | <i>E. strattonata</i> Pack. |
| <i>E. castigata</i> Hbn. | <i>E. coagulata</i> Gn. |
| <i>E. albipunctata</i> Haw. | <i>E. nimbicolor</i> Hlst. |
| <i>E. fletcherata</i> Tayl. | <i>E. gelidata</i> Moesch. |
| <i>E. kasloata</i> Tayl. | <i>E. kandnaskata</i> MacK. |
| <i>E. luteata</i> Pack. | <i>E. perfusca</i> Hlst. |
| <i>E. palpata</i> Pack. | <i>E. sobrinata</i> Hbn. |
| <i>E. transcanadata</i> MacK. | <i>E. niphadophilata</i> Dyar |
| <i>E. ornata</i> Hlst. | <i>E. filmata</i> Pears. |
| <i>E. pseudotsugata</i> MacK. | <i>E. annulata</i> Hlst. |
| <i>E. sheppardata</i> McD. | <i>E. cretacea</i> Pack. |
| <i>E. columbiata</i> Dyar | <i>E. albicapitata</i> Pack. |
| <i>E. placidata</i> Tayl. | <i>E. togata</i> Hbn. |
| <i>E. satyrata</i> Hbn. | <i>E. spermaphaga</i> Dyar |
| <i>E. arceuthata</i> Fr. | <i>E. ravocostaliata</i> Pack. |
| | <i>E. anticaria</i> Wlk. |

The larvae may be green, brown, or grey, or pale grey with dark patches (Figs. 173-190 and 195). The amazing diversity of colour pattern in European species has been illustrated by Dietze (1910-1913) and Juul (1948).

The larvae of one species or another of *Eupithecia* may be found feeding

at any time between late spring and early fall on foliage of many different kinds of coniferous and angiosperm plants, on flowers, and in the cones of spruce (*Picea*), fir (*Abies*), hemlock (*Tsuga*) and Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco).

Lobophorini

The larvae of *Nyctobia* Hulst, and *Lobophora* Curtis, are green in colour and moniliform in appearance (Figs. 7 and 9). They are from 13 to 22 mm. in length. The cuticle is slightly rough (Fig. 99). The depth of the labral notch is about one-fifth the width of the labrum (Fig. 58). The mandibles resemble some of the Hydriomenini (Fig. 73). The spinneret does not extend beyond the labial palpi (Fig. 78). The thoracic claw is curved (Fig. 121). There are from three to six annulets on the third abdominal segment. The setae are short and pale in colour. On the head, setae A-3 are anterior to a line drawn between setae L-1 and A-2 (Fig. 22). On the third abdominal segment setae D-1, SD-1 and L-2 are in line and setae SV-3, SV-1 and V-1 are in line (Figs. 191 and 192). On the anal plate setae D-1 are anterior to a line drawn between setae SD-1 (Figs. 206 and 207). The crochets on the ventral proleg number from 8 to 18, in two groups. The setae on the side of the ventral proleg number four. The hypoproct is small and the paraprocts are short in *Nyctobia*, and long in *Lobophora* (Fig. 207).

Key to Genera (Mature Larvae)

| | |
|---|------------------|
| Larvae with long paraprocts (Fig. 207); feed on <i>Populus</i> and <i>Salix</i> | <i>Lobophora</i> |
| Larvae with short paraprocts; conifer feeders..... | <i>Nyctobia</i> |

Nyctobia Hulst

The species, *N. limitaria* Wlk., feeds from the middle of May until the middle of August on the new growth of spruce (*Picea*), fir (*Abies*), larch (*Larix*), hemlock (*Tsuga*), Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco), and occasionally the two-needled pines (*Pinus*).

Lobophora Curtis

The larvae of *L. nivigerata* Wlk. and *L. magnoliatoidata* Dyar feed in late summer on aspen (*Populus tremuloides* Michx.).

Eudulini

The long, slender larva of *Eudule mendica* Wlk. has a total length of about 25 mm. It is flesh-coloured with brown markings and green suffusion. The cuticle is rough (Figs. 101 and 102). The depth of the labral notch is about one-third of the width of the labrum (Fig. 56). The mandible is triangular in shape (Fig. 69). The spinneret is very short (Fig. 79). The thoracic claw is slightly curved (Fig. 120). There are from 12 to 16 annulets on the third abdominal segment. The setae are short, dark brown, pointed. There is a total of six setae in the L, SV, and V groups of the first abdominal segment (Fig. 125). The setae of the third abdominal segment are widely scattered (Fig. 193). The crochets of the ventral proleg number about 10 and the setae on the side of the leg number 4. Setae D-1 of the anal plate are posterior to a line drawn between setae SD-1 (Fig. 204). The hypoproct and paraprocts are small. The larvae feed on violets (*Viola*) in June and July.

RELATIONSHIPS

The Larentiinae is, "a good-sized subfamily, with the classification at present in considerable confusion," (Forbes, 1948). A few writers have attempted to give some order to this confusion by grouping the genera into tribes. Meyrick (1895) based his arrangement, for the most part, on wing

venation; Pierce (1914) developed his plan after a study of the genitalia. Forbes (1948) worked out his classification following investigations on a number of characters. In addition to these works there is the list of McDunnough (1938) and a European treatise by Hoffmeyer (1952). Each of these resembles one or more of the others in some respects but no two of them are the same. None of these workers have made very much use of the information that may be gleaned from a study of immature forms. The present work shows that larvae, at least, should not be overlooked when one is attempting to determine relationships within this subfamily. Common characters have been noted in groups of genera. One might expect that some genera, as shown by these characters, are more specialized than others. Before going into that it is pertinent to note that this study has been carried out on the larvae of one region, the Nearctic, and on only half the genera of this region, and it is to be expected that many of the obscure points about larentiine affinities will not be solved until larvae of other genera and regions of the world have been examined.

Not all characters are of equal value in determining the phylogeny of a subfamily. Many are of no use in this respect. Meyrick (1895) pointed out that a combination of several characters which are apparently not interdependent carries very great weight. While searching for these characters I was impressed by the close affinity of some groups of genera. Although the proposed schemes to show the phylogeny of the Larentiinae underwent many changes a new characters were studied on a comparative basis, the close relationship of certain genera became apparent. Among these may be cited as examples the genera of the tribes Xanthorhoini, the Asthenini, the Operophterini, the Mesoleucini, and the Lobophorini and, in the Hydriomenini, these genera formed subtribes: *Calocalpe* and *Coryphista*; *Eustroma*, *Lygris*, and *Ceratodalia*; and *Plemyria*, *Dysstroma*, and *Thera*. Six characters seemed to be satisfactory for separating groups of genera. These are the characters:

1. Setae, once acquired, are retained in the evolution of the Larentiinae.
2. Setae of the anterior abdominal segments are arranged in two almost parallel lines in primitive genera and are scattered in specialized ones.
3. Setae of the more primitive types are long and of the specialized types short.
4. Thoracic claws have evolved from a simple type with an acute notch to a specialized type with a well-rounded notch.
5. The spinnerets of the generalized genera are long, often on a long hypopharynx, and of the specialized genera short, beyond which the labial palpi project.
6. The paraprocts and, to a lesser extent, the hypoproct, show development from those of a small size in the generalized forms to those of a large size in the specialized forms.

Meyrick (1895) derived the Larentiinae (Hydriomenidae) from the Monoctenidae. In the latter was *Brephos*, a genus generally accepted as primitive. The larvae of *Brephos* and *Leucobrephos* appear to be primitive. They have vestigial prolegs on the third, fourth and fifth abdominal segments; there are only six setae in the L, SV, and V groups of the first and second abdominal segments; seta L-4 is absent on the abdomen (Figs. 128 and 136); the setae are moderately long and arranged in rows on the anterior abdominal segments. The thoracic claw is straight with an acute notch. The spinneret extends beyond the labial palpi. Larvae of the subfamilies Geometrinae, Sterrhinae, Ennominae, and Oenochrominae have seta L-4 (Figs. 135, 137 and 138) but this seta is never present in the Larentiinae. (A few larvae of *Epirrita*

had two setae in the L-3 position, but on one side only). The absence of seta L-4 in the Larentiinae suggests that this subfamily, like the Brephinae, is more primitive than the others. In most genera of the Larentiinae there are three SV setae on the first abdominal segment (Figs. 123, 126, and 127), but in a few (*Venusia*, *Hydrelia*; *Coryphista*, *Calocalpe*, *Rheumaptera*, and *Eudule*) there are only two on the first abdominal segment (Figs. 124 and 125). Unlike the Brephinae, all genera of the Larentiinae have three SV setae on the second abdominal segment; this it is thought indicates that the Brephinae are more primitive than the Larentiinae. The presence of two SV setae on the first abdominal segment of some genera and three in other genera may be taken to show that the former are more primitive than the latter. With the exception of *Eudule*, these genera (*Rheumaptera*, *Calocalpe*, *Coryphista*, *Venusia*, and *Hydrelia*) have long setae, which on the anterior abdominal segments are in two rows (Figs. 141, 142, 146, 147 and 148), claws with an acute-angled notch (Figs. 103, 104, and 106), and spinnerets that often extend well beyond the labial palpi (Fig. 82).

The Asthenini (*Venusia* and *Hydrelia*) appear to be more primitive than the primitive genera of the Hydriomenini because they have not only spinnerets extending well beyond the labial palpi but also very acutely-angled thoracic claws. From the Asthenini, therefore, probably came the Hydriomenini. From this tribe also came not only the Operophterini as Meyrick (1895) thought but also probably the Mesoleucini. For the present I consider that the Xanthorhoini also sprang from the Asthenini but there must have been a number of transitional genera between these two tribes. The Operophterini are more specialized than the Asthenini as they have three SV setae on the first abdominal segment but they resemble the Asthenini in these characters: spinneret extending well beyond the labial palpi, thoracic claw acutely-angled, setae long and, on anterior abdominal segments, arranged in rows, and a simple colour pattern of lines and stripes. The Mesoleucini likewise have three SV setae on the first abdominal segment indicating they are more specialized than the Asthenini. The Mesoleucini resemble the latter as they possess long spinnerets, long setae, which on the anterior abdominal segments are arranged in two rows in *Earophila*, and a green colour pattern, ornamented with middorsal markings in *Mesoleuca* not unlike that in some *Venusia*.

In the Xanthorhoini, *Epirrhoe* is thought to be most primitive and the other four genera follow in this order: *Xanthorhoe*, *Camptogramma*, *Percnoptilota*, and *Zenopheps*. This arrangement has been determined mainly by a study of setal patterns on the third abdominal segments.

The Stammodini, represented by *Stammoctenis*, may have developed from the Xanthorhoini. Setal patterns, particularly of the abdominal segments, and the number of secondary setae (11) on the ventral proleg suggest a relationship to this tribe. The form of the hypopharynx, the arrangement of the setae, and the colour pattern of stripes suggest that *Stammoctenis* is primitive but the number of setae on the proleg and the small size of the body setae seem to indicate that these larvae are of a specialized type. The Stammodini can probably only be assigned to the proper position in this phylogeny when representatives of more genera have been examined.

The Hydriomenini, as here limited, is a large tribe which consists of a group of primitive genera (*Calocalpe*, *Coryphista*, and *Rheumaptera*) from which branches in one direction *Triphosa* and *Hydriomena* and in the other a large group of genera: *Euphyia*, *Diactinia*, *Eustroma*, *Lygris*, *Ceratodalia*, *Trichodezia*,

Plemyria, *Dysstroma*, and *Thera*. Within this tribe development may be traced in four characters. From *Calocalpe* to *Thera* there is a gradual shortening of the spinneret with respect to the length of the labial palpi; there is a change from a strongly-curved thoracic claw to an almost straight one; the setae of the third abdominal segment shift from a pattern of two lines in *Calocalpe* to a scattered pattern in *Thera*; and there is a gradual development of the paraprocts, and to some extent, the hypoprocts, to the interesting forms seen in *Plemyria*, *Dysstroma* and *Thera*. A similar development, but on a reduced scale, may be seen in most of these characters in the transition from *Calocalpe* to *Hydriomena*.

The Eupitheciini probably developed from the primitive Hydriomenini but there are a number of "missing links" in this branch. Setal patterns, the shapes of the thoracic claw and the decrease in length of the spinneret, from the *Calocalpe-Coryphista* group through the Eupitheciini, tend to support this suggested origin. There are two types of setal pattern on the anal plate of the Eupitheciini (Figs. 210 and 212). *Horisme* has the type common to all other tribes but the Lobophorini, and *Eupithecia* has a type found elsewhere only in the Lobophorini. The Lobophorini may have developed from a *Eupithecia*-like ancestor.

There are still the Eudulini to place in this scheme of relationships. *Eudule* has only two SV setae on the first abdominal segment; this suggests the genus is primitive. On the other hand these larvae have short spinnerets, specialized claws, rough cuticle, setal patterns of head and abdomen different from all other tribes, and a specialized food preference. The study of larvae of one species of one genus has not solved the origin of this tribe. There seems to be a relationship to the Eupitheciini but these affinities may be more apparent than real (Fig. 216).

PART II IDENTIFICATION GUIDE AND DESCRIPTIVE CATALOGUE OF THE SPECIES

INTRODUCTION

The larentiine species examined in the preparation of Part I are described in detail in this Part. In addition a number of species discussed by other workers have been included. Where at all possible, keys have been presented for the separation of the species. The writer realizes that many of these keys have imperfections but these imperfections are, in large part the result of our inadequate knowledge of the larvae of the subfamily. As we learn more about the larvae, the keys can be improved.

The characters of most use in the preparation of these keys are colour pattern, nature of the cuticle, shape of the head, size of the head, length and width of the larva (shape), number of crochets on the prolegs, and the number of setae on the side of the ventral proleg. In Part I, it was necessary to refer to food-plant preferences and time of feeding to separate some genera. These food habit characteristics, as well as geographical distribution, are of even more help in defining larval species.

A large part of the description concerns the colour patterns of the head, thorax, and abdomen. A scheme for describing the colour pattern of the abdomen has been arranged (Fig. 139). In this the line or stripe along the dorsomeson is the middorsal (M.D.); the line or stripe bearing the Dorsal setae is the addorsal, (A.D.); the region between the D setae and the SD-1 setae, including the latter, is the subdorsal (S.D.); the region below that, including the spiracles and setae L-1 and L-2, is the lateral, (L); the line bearing the SV

setae is the subventral, (S.V.); the line with setae V on the legless segments is the adventral, (A.V.); and the line down the middle of the venter is the midventral, (M.V.).

Another scheme for convenience in using the descriptions has been arranged.

Outline of Description Pattern

Genus, Species, Authority. Figures:

References:

Range:

Host: (Plants known by the writer to be acceptable to the larvae are listed first and plants mentioned in the literature are listed after the reference. Ex. *Epilobium angustifolium* L., *Thalictrum*; Forbes (1948): *Impatiens*.

Life History: (Unless otherwise stated the data on life history are based on studies made by the writer).

Description: (Instar) I-V, or Ultimate:

Measurements: (These measurements are always for last or ultimate instar larvae). H.W., (head width); W/L, (ratio of width of head to length of head); B.L., (total larval length); B.W. (greatest larval width, this measurement is considered satisfactory when taken to the nearest tenth of a millimetre as larval width is often very variable); annulets (number of annulets in third abdominal segment). Number of crochets, in one or two groups, and number of secondary setae on ventral proleg. Number of larvae examined.

Remarks:

THE NEARCTIC SPECIES: KEYS AND DESCRIPTIONS

Tribe Asthenini

HYDRELIA Hübner

H. ALBIFERA Walker. Figs. 24, 124, and 146.

Range: Newfoundland to Pennsylvania, and west to Rosedale in southern British Columbia (Forbes, 1948; Jones, 1951).

Host: *Cornus stolonifera* Michx.

Life History: Larvae free-living, late July and August; hibernate as pupae; adults in June and July.

Description: *Ultimate*: Head: cuticle smooth, or almost so; pale green or pale russet-green, with pale brown specks, or a dark brown or black spot on the upper part of each parietal lobe; ocellar area brown, or very pale green, or concolorous. Thorax and abdomen slightly rough; green, may be a grey line between setae D and SD. Setae long, brown, pointed.

Measurements: H.W., 0.97-1.17 mm.; W/L, 1.72-1.75; B.L., 9-10 mm.; B.W., 1.0-2.0 mm.; annulets, 4; ventral proleg with 18 crochets in two groups, and 4 secondary setae. No. of larvae examined: 7.

VENUSIA Curtis

Key to Species (Mature Larvae)

1. Larvae feed in August and September; larvae often have red dorsal markings... *V. cambrica*
Larvae feed in May, June and July; larvae sometimes have rosy suffusion on abdomen 2
2. Species occurs in British Columbia and mountainous Alberta *V. pearsalli*
Species occurs in eastern North America *V. comptaria*

V. CAMBRICA Curtis

Reference: Stokoe and Stovin (1948).

Range: From the Atlantic to the Pacific Oceans, north to Alaska and south to northern California.

Hosts: *Alnus*; Forbes (1948): *Sorbus americana* Marsh.

Life History: Larvae free-living, August and September; hibernate as pupae; adults early June until the middle of August (Ferguson, 1955a).

Description: *Ultimate*: Head: cuticle smooth, or almost so; pale green. Thorax and abdomen slightly rough; pale or yellow green, sometimes with a red triangular marking on the dorsum of first six abdominal segments, a yellow line between setae D and SD, and red markings in the lateral area; M.V., concolorous or very pale green. Setae long, brown, pointed.

Measurements: H.W., 1.20-1.50 mm.; B.L., 12-18 mm.; B.W., 1.5 mm., No. of larvae examined: 3.

Remarks: Descriptions based on two larvae that became male moths.

V. PEARSALLI Dyar. Figs. 25, 60, 103, 147, and 199.

Range: Southwestern Alberta (Bowman, 1951) and southern British Columbia (Jones, 1951).

Host: *Alnus*.

Life History: Eggs laid in spring on unfolding leaves and on twigs; hatching four to ten days after oviposition; larvae free-living, three instars, middle of June-July 20; hibernation in pupal stage; adults April, May, and June.

Description: *I*. Pale yellow. H.W., 0.34-0.38 mm.; B.L., 3.0-5.0 mm.; B.W., 0.4 mm. *II*. Green. H.W., 0.75-0.80 mm.; B.L., about 13 mm.; B.W., 1.9 mm. *III*. Head: cuticle smooth, or almost so, pale russet green. Thorax and abdomen slightly rough or reticulate, pale green or green. M.D., blue-green line, S.D., a white stripe between setae D and SD. Setae long, brown, pointed.

Measurements: H.W., 1.19-1.45 mm.; W/L., 1.61-1.94; B.L., 12-20 mm.; B.W., 1.5-2.0 mm.; annulets 4; ventral proleg with 16-30 crochets in one group, and 4 secondary setae. Number of larvae examined: 10.

Remarks: Descriptions based on larvae reared from gravid females.

V. COMPTARIA Walker

Range: Nova Scotia to Ontario, and south to Washington, D.C. (Forbes, 1948).

Hosts: *Alnus*, *Sorbus americana* Marsh.

Life History: Eggs laid in spring; larvae free-living, three instars, May and early June; pupae overwinter (M. R. MacKay, *in litt.*); adults early April-early June (Ferguson, 1955a).

Description: *I*. H. W., 0.30 mm.; *II*. H.W., 0.84-0.92 mm. *III*. Head: cuticle slightly rough, probably pale green (colour removed in preserved material examined); thorax and abdomen slightly rough, or reticulate; probably green. Setae long, brown, pointed.

Measurements: H.W., 1.28-1.34 mm.; W/L., 1.53-1.84; B.L., 8-16 mm.; B.W., 2.2-2.7 mm.; annulets, 4; ventral proleg with 20-30 crochets in one group and 4 secondary setae. No. of larvae examined: 5.

Tribe *Xanthorhoini*

EPIRRHOE Hübner

Mature Larvae (Key to Species)

1. Middorsal line continuous; larvae feeding in July and August in Alberta.....*E. speyeri*
Middorsal line not continuous; larvae may feed from May to August in Alberta..... 2
2. Each of first five abdominal segments with a brown cross on the dorsum.....*E. alternata*
Each of first five abdominal segments with an inverted dark brown triangular spot
tipped with white on the dorsum.....*E. plebeculata*

E. SPEYERI Herbulot. Fig. 8

Range: Alberta and British Columbia.

Host: *Galium boreale* L.

Life History: Eggs laid on July 14, hatched July 19; free-living larvae (four instars) pupated August 17-25; hibernation in pupal stage; adults fly from May until early July.

Description: *I.* Pale rust-coloured head and pale green body. H.W., 0.34-0.36 mm.; B.L., about 2.7 mm.; B.W. about 0.38 mm. *II.* Head yellow with no markings; body pale yellow-green with grey lines running lengthwise; prothoracic plate yellow; H.W., 0.56 to 0.67 mm.; B.L., about 6.0 mm.; B.W., about 1.10 mm. *III.* Head pale brown with fine brown spots arranged in herring-bone pattern along epicranial stem and over parietal lobes; body pale grey with brown middorsal line, light brown line near Dorsal setae and two wide brown lines in subdorsal region; below the spiracles, a broad yellow stripe; three pale brown lines in subventral area; midventral line brown. H.W., 0.92 to 1.06 mm.; B.L., about 13 mm.; B.W., about 1.2 mm. *IV.* Head: cuticle smooth to finely reticulate; pale brown with a pattern of brown herring-bone markings along the epicranial stem and cleavage line and a dark brown bar along the head to the ocellar area. Thorax and abdomen slightly rough, pale grey; M.D., brown; A.D., light line near Dorsal setae; S.D., wide brown stripe; L., dark brown line, in spiracular area; S.V., brown stripe; A.V., light brown stripe; M.V., brown line. Setae long, brown, pointed.

Measurements: H.W., 1.52-1.71 mm.; W/L., 1.58-1.75; B.L., about 17 mm.; B.W., about 1.7 mm.; annulets 6; ventral proleg with 28-30 crochets in one group and 10 secondary setae. No. of larvae examined: 10.

Remarks: Descriptions based on larvae reared from a gravid female.

E. ALTERNATA Muller. Figs. 32, 61, 67, 110, 160 and 196.

Reference: Stokoe and Stovin (1948).

Range: Holarctic; in Canada, from Nova Scotia to British Columbia.

Host: *Galium*.

Life History: Free-living larvae (four instars) feed in June and August (probably two generations); hibernate as pupae; adults from June to August.

Description: *I.* H.W., 0.34-0.38 mm. *II.* and *III.* Not available. *IV.* Head: cuticle smooth or finely reticulate; pale grey with brown dots grouped in herring-bone pattern along the epicranial stem; frons and adjacent area on parietals, brown; a series of brown dots arranged in an arc from occiput to ocellus 6. Thorax and abdomen slightly rough, pale grey; M.D., dark brown line on the thorax and posterior abdominal segments; each of first five abdominal segments has a brown cross on dorsum; irregular brown lines on sides and venter; M.V. a broken brown line (Fig. 160). Setae long, pale brown, pointed.

Measurements: H.W., 1.54-1.75 mm.; W/L., 1.49-1.73; B.L., 17-20 mm.; B.W., 1.9-2.3 mm.; annulets 6-7; ventral proleg with 27-34 crochets in one group, and from 8-10 secondary setae. Number of larvae examined: 8.

E. PLEBECULATA Guenée

Reference: Hardy (1954a).

Range: Alberta and British Columbia.

Host: *Galium*.

Life History: Eggs laid in April; free-living; nocturnal-feeding larvae (four

instars) from end of April to end of May; probably hibernate as pupae; adults from March to June.

Description: *I.* Head light brown speckled with dark brown; body translucent, later becoming dull bluish-green as food is ingested. B.L., 1.0 mm. *II.* Head as in *I*; body pale greenish-grey with white dorsal line and lemon-coloured intersegmental rings; B.L., 5.0 mm. *III.* Head as in *I*; body pale green to brown; with six fine, white lines, interrupted at the juncture of each segment by a pale lemon-coloured ring encircling the body; B.L., 10 mm. *IV.* Head pale beige, spotted with black; thorax and abdomen light reddish to greyish-brown; M.D., black line on thorax and last four abdominal segments; first five abdominal segments each with a dark brown or black mark consisting of an inverted triangular dark brown spot tipped with white; L, spiracular line white, marked on the fourth and fifth segments with a thick brown oblique dash; SV and AV grey with four white lines.

Measurements: Length of body 15-16 mm.

XANTHORHÖE Hübner

There is so much variability in the colour patterns of this genus and as only a single larva has been seen in several species, no key has been prepared to separate the species.

X. PACKARDATA McDunnough. Figs. 36, 159, and 201.

Range: New York (Forbes, 1948).

Host: *Alyssum*.

Life History: Larvae feed in August; probably hibernate as pupae; adults in May and late July and August.

Description: *Ultimate*: Head: cuticle smooth to slightly rough, pale, with brown markings in herring-bone pattern along epicranial stem and above ocellar area; clypeus pale with two brown dots at apex, a brown dot in each basal corner, and pale brown along the sides. Thorax and abdomen rough, pale brown; M.D. and A.D., a diamond-shaped patch on each of the first six abdominal segments; S.D. and L., sides of body mottled with brown; subspiracular line white on thorax and first two abdominal segments, elsewhere pale brown; SV and AV, brown lines; MV may be a geminate brown line (Fig. 159). Setae brown, pointed, of moderate length.

Measurements: H.W., 1.17 mm.; W/L, 1.39; B.L., 15 mm.; B.W., 2.0 mm.; annulets, 5; ventral proleg with 18-20 crochets, and 8 or 9 secondary setae. No. of larvae examined: 1.

X. DESIGNATA EMENDATA Pearsall.

Range: Nova Scotia and Quebec, south to North Carolina and west to British Columbia.

Host: *Alyssum*.

Life History: Larvae of *X. designata* Hufnagel in June and July in Great Britain (Stokoe and Stovin, 1948), and of *X. designata emendata* in September in New York (L.R. Rupert *in litt.*) probably hibernate as pupae, adults from May to August (Bowman, 1951; Ferguson, 1955a).

Description: *Ultimate*: Head: cuticle smooth, to slightly rough; pale, with brown markings in herring-bone pattern along epicranial stem and above ocellar area; clypeus pale, with brown dots and shading. Thorax and abdomen pale brown, with pattern much as in *X. packardata*, but with more dark brown colour in dorsal area; posterior abdominal segments paler than anterior ones. Setae brown, pointed, of moderate length.

Measurements: H.W., 1.38 mm.; W/L, 1.47; B.L., 16 mm.; B.W., 2.0 mm.; annulets, 5. No. of larvae examined: 1.

X. LACUSTRATA Guenée

Reference: Dyar (1899c), as *Mesoleuca intermediata* Packard.

Range: Nova Scotia and Quebec, to Virginia, and west to Alberta and Texas (Forbes, 1948); southern British Columbia (Jones, 1951).

Host: *Impatiens*.

Life History: Eggs June 30; mature larvae July 17, (four instars); adults July 30 (Dyar, 1899c).

Description: *I.* Head white; body colourless, food shows through body wall; H.W., 0.3 mm. *II.* Head pale yellow; body dark green from food; tracheal line white; no marks; H.W., 0.5 mm. *III.* Head dull yellow; body yellow. Later there are faint, narrow, white addorsal and subdorsal lines between which a dorsal white shade appears, joining them; H.W., 0.85 mm. *IV.* Head: cuticle smooth or almost so; "luteous" (Dyar's term), with a broad black band to apex of each parietal lobe, clypeus immaculate. Thorax and abdomen rough, brown; M.D., series of dashes and patches; S.D., several wavy brown lines; S.V., two or three wavy brown lines. Setae brown, pointed, of moderate length.

Measurements: H.W., 1.42 mm.; W/L, 1.42; B.L., 22 m.; B.W., 2.5 mm.; annulets, 5; ventral proleg with 18 crochets. No. of larvae examined: 1.

X. MUNITATA Hübner, and X. MUNITATA CONVALLARIA Guenée

References: Dyar (1905b) described *X. m. convallaria*; Stokoe and Stovin (1948) described *X. munitata*.

Range: Holarctic. Arctic-alpine; widespread in Canada (Forbes, 1948).

Host: Stokoe and Stovin (1948): *Alchemilla*, *Stellaria*, *Senecio*.

Life History: Larvae hibernate in Great Britain and Ireland (Stokoe and Stovin, 1948); four instars in *X. munitata convallaria*; adults in July and August.

Description: *I.* Head pale brown; body dark sordid olivaceous with short capitate setae; no markings. *II.* Head white; dotted on the sides with dark brown; body translucent green from the food; broken dorsal, faint subdorsal, distinct lateral, faint supraspiracular brown lines, the lateral line olivaceous brown; venter finely streaked in brown. H.W., 0.5 mm. *III.* Head pale luteous, a linear dotted band from the antennae to the outer side of the vertex and a second faint one within; body pale, on abdominal segments 2 to 5, a small black dorsal spot and two small subdorsal ones; dorsal, subdorsal, lateral and supraspiracular lines faint red; subventer pale; venter obscurely red lined. H.W., 0.9 mm. *IV.* Head: cuticle smooth or slightly rough; pale, with brown markings in herring-bone pattern along epicranial stem and above ocellar area; clypeus pale. Thorax and abdomen pale mottled with purplish-brown on abdominal segments 1 to 5 inclusive, a black patch anteriorly, one before, and a small one mesad, of seta D-2; faint dotted lines in A.D. and S.D. regions; lateral area pale; S.V., broken brown stripe; A.V., pale brown, edged with brown; M.V., pale brown striped. Setae moderately long, brown, pointed.

Measurements: H.W., 1.34-1.36 mm.; W/L, 1.34-1.36; B.L., 22-25 mm.; B.W., 1.8-2.2 mm.; annulets, 5; ventral proleg with 15 crochets in two groups and 8-9 secondary setae. No. of larvae examined: 4.

X. FERRUGATA Clerck and X. FERRUGATA FORM UNIDENTARIA Haworth. Fig. 59.

Reference: Fletcher and Gibson (1907).

Range: Holarctic. Both *X. ferrugata* and *X. ferrugata* form *unidentaria* occur across Canada (Ferguson 1955a; Jones, 1951).

Host: Stokoe and Stovin (1948): *Taraxacum officinale* Weber, *Glechoma bederacea* L., *Polygonum aviculare* L.

Life History: Eggs laid May 23; hatched June 1; four instars; mature larvae June 18; pupated June 20; adults emerged June 29 and 30 (Fletcher and Gibson, 1907); two generations in Great Britain (Stokoe and Stovin, 1948) and probably two generations in eastern Canada as larvae have been collected at South March, Ontario in early October (M. R. MacKay, *in litt.*); adults throughout summer.

Description: N.B. Stages I-III, of *X. ferrugata*, after Fletcher and Gibson (1907); Stage IV, of *X. ferrugata* f. *unidentaria*. *I.* Head, pale brown with sides black; body pale yellowish-brown. H.W., 0.3 mm.; B.L., 2.2 mm. *II.* Head brown, with pale clypeus; body reddish-brown, dorsal vessel lined with white on each side; a double lateral stripe of white is present, the upper one being very wavy; subspiracular (infrastigmatal) stripe double, irregular at edges, most conspicuous on thoracic and anal segments; midventral stripe double, wider than middorsal; all of these stripes yellowish-white, on a warm brown ground. H.W., 0.5 mm.; B.L., 4.5 mm. *III.* Head grey, spotted with dark brown, and with a black stripe across the cheeks to the mouth; this stripe, margined above and below with white, is a continuation of the dark subdorsal lines; body dark purplish-brown; middorsal stripe more or less broken up on abdominal segments into diamond-shaped marks; between spiracular fold and geminate midventral stripe is single white line, which runs down on prolegs and joins the pale line of midventral stripe. H.W., 0.8 mm.; B.L., 8 mm. *IV.* Head: cuticle smooth or slightly rough, pale grey with a brown bar from dark subdorsal lines of thorax to base of antenna; brown spots, roughly in herring-bone pattern, along epicranial stem; brown dots on clypeus, two about half way to apex and one in each basal corner; short dark brown bar from occiput to ocellar area. Thorax and abdomen pale grey; M.D., dark brown dash at anterior edge of abdominal segments and brown dash in middle of abdominal segments where cross-marking occurs, on segments 2 to 5 inclusive; on posterior abdominal segments, M.D., geminate brown line; S.D., two brown lines; L. pale grey stripe; S.V., broken geminate brown; A.V., geminate; thoracic legs pale grey with brown dots; prolegs pale grey; ventral proleg has dark brown streak along anterior edge, half way down leg; anal leg has brown stripe the length of the leg. Setae moderately long, brown, pointed.

Measurements: H.W., 1.30-1.40 mm.; W/L, 1.34-1.57; B.L., 14-25 mm.; B.W., 2.3-2.7 mm.; annulets, 5; ventral proleg with 13-18 crochets, in one group, and 8-9 secondary setae. No. of larvae examined: 10.

X. DEFENSARIA Guenée

Reference: Hardy (1949).

Range: Southern British Columbia and Vancouver Island. (Jones, 1951).

Hosts: Jones (1951): *Salix*, *Alnus*, *Ribes*, *Acer*.

Life History: Eggs laid September 20, 1947, hatched 18 days later; four instars; pupation December 6-12. (Under natural conditions egg may be hibernating stage); adults in spring and fall (Hardy, 1949).

Description: *I.* Head light pinkish-cinnamon; body translucent with a tinge of green. B.L., 2.0 mm. *II.* Colour much as in *I.* B.L., 6.0 mm. *III.* Head mottled brown on green background; thoracic and last abdominal segments

green, the remainder pale cinnamon, with a pattern of small black spots on dorsum; these spots mark the outline of an X and are in the form of four black dots with a central, longitudinal black dash between them. B.L., 12-17 mm. *IV*. Head as in *III*; body with pattern much as in *III*, but with an interrupted wavy lateral line of dark brown, continuous on last three abdominal segments and numerous, very fine longitudinal white lines on dorsal and ventral surfaces; these lines are grouped in threes or fours, each group bounded by a more strongly marked line. B.L., 20-22 mm.

Remarks: "The theory is advanced that all the named forms of this species are seasoned variations, and could be produced in one season by successive breeding from one set of parents." Hardy (1949).

CAMPTOGRAMMA Stephens

C. STELLATA Guenée. Figs. 35, 123, 157, and 203.

Reference: Dyar (1900b), as *Gypsochroa haesitata* Hulst.

Range: Tropical America (Forbes, 1948).

Host: *Pisonia aculeata* L.

Life History: Larvae (four instars) feed in March in Florida (probably two or more generations); adults have been collected in early September in Nova Scotia (Ferguson, 1955a).

Description: *I*. Head very pale brown, a narrow dark line on posterior edge of parietal lobe; body dull green, with numerous, fine, longitudinal, pale streaks. H. W. 0.4 mm. *II*. Head brown, speckled with darker colour; a faint, grey V-shaped shade bordering the clypeus. Body green, with brown shading; faintly lined. H.W., 0.7 mm. *III*. Head whitish, densely mottled with pale brown. Body whitish-green, with irregular rows of white specks. H.W., 1.2 mm. *IV*. Head: cuticle smooth or almost smooth; whitish-green, thickly mottled with spots of dull olive-green; may have brown markings in herring-bone pattern along epicranial stem and on sides. Thorax and abdomen, smooth or almost smooth; green, mottled with irregular lines and spots of more opaque yellowish-green; black specks between dorsal setae on abdominal segments 1 to 7, heaviest on 6 and 7; black spots on subventral fold, heaviest on abdominal segments 6 and 7 (Fig. 157); legs green, brown speckled. Setae long, pale brown, pointed.

Measurements: H.W., 1.54-1.90 mm.; W/L, 1.37-1.80; B.L., 17-23 mm.; B.W., 2.0-2.5 mm.; annulets, 5; ventral proleg with 18-26 crochets in two groups, and 9-10 secondary setae. No. of larvae examined: 4.

PERCNOPTILOTA Hulst

P. OBSTIPATA Fabricius. Figs. 38, 72, 81, 115 and 158.

References: Dyar (1899b); Barnes and McDunnough (1912).

Range: Forbes (1948) states species is world wide; Jones (1951) makes no mention of it in British Columbia.

Hosts: Dyar (1899b): *Polygonum*; Barnes and McDunnough, (1912): *Rumex*.

Life History: Dyar (1899b) noted, at Long Island, New York, eggs laid July 12; in four instars, mature larvae August 2; adults August 12. May be several generations in warmer parts of range.

Description: *I*. Head brown; body sordid brown, without marks (Dyar, 1899b); head slightly red, body entirely dull greenish-black (Barnes and McDunnough, 1912). H.W., about 0.3 mm.; B.L., 2.0 mm. *II*. Head pale brown; body pale brown with five narrow, dark brown lines on the dorsum (Dyar); head slightly red; body greenish-white with faint traces of geminate dorsal and subdorsal lines; abdominal segments with rather diffuse lateral purple

patches (B. & McD.). H.W., 0.4 mm.; B.L., 6.0 mm. *III*. Head sordid luteous, two vertical shades of brown dots extending up the face of each lobe; body yellow, or green from food; dorsal, addorsal, and subdorsal lines, narrow, wavy and broken, and traces of a stigmatal (spiracular) line, distinct centrally on the segments, spiracles brown shaded, and subventral spots about the tubercles, giving a superficial resemblance to broken transverse bands (Dyar). Head light green, mottled with red; body green with geminate light yellow dorsal stripe tending to diamond-shaped enlargements on segmental incisions; two dorsal yellow lines; lateral portions tinged with reddish-purple which on abdominal segments forms indistinct transverse bands across the body at junction of segments; beneath yellowish-green (B. and McD.). H.W., 0.7 mm.; B.L., 9-10 mm. *IV*. Head: Cuticle lightly reticulate; pale brown, thickly dotted with dark brown; a diffuse white stripe on the face of each lobe widening above; apex of clypeus brown (Dyar); or, head white, striped and sprinkled with red (B. and McD.). Thorax and abdomen, slightly rough; green to reddish-brown; M.D., and S.D., indistinct geminate stripes; the abdominal segments are crossed by 5 purplish intersegmental bands, most distinct in the green larvae; laterally these bands are often terminated by a black longitudinal dash (B. and McD.) (Fig. 158). Setae long, pale brown, pointed.

Measurements: H.W., 1.00 - 1.39 mm.; W/L, 1.45 - 1.75; B.L., 13 - 19 mm.; B.W., 1.0 - 1.7 mm.; annulets, 4. Ventral proleg with 12 - 36 crochets, in one or two groups, and 8 or 9 secondary setae. No. of larvae examined: 10.

ZENOPHLEPS Hulst

Z. LIGNICOLORATA Packard. Figs. 37, 116, and 155.

Range: Southern Alberta (Bowman, 1951); southern British Columbia (Jones, 1951).

Hosts: *Picea engelmannii* Parry; *Pinus flexilis* James.

Life History: Free-living larvae in June; pupal period lasts about three weeks; adults in July and August.

Description: *Ultimate*: Head, cuticle smooth, or almost smooth; pale grey with grey herring-bone markings along the epicranial stem and on the sides of the head. Thorax and abdomen, smooth, or almost smooth; pale grey; M.D., grey, broken; grey diamond on each of abdominal segments 2 to 5; A.D., and S.D., greyish markings on dorsum; M.V., geminate grey (Fig. 155). Setae long, brown, pointed.

Measurements: H.W., 1.90 mm.; W/L, 1.89; B.L., 18 mm.; B.W., 2.0 mm.; annulets, 5; ventral proleg with 18 crochets in two groups and 10 secondary setae. No. of larvae examined: 2.

Tribe Stammodini

STAMNOCTENIS Warren

S. MORRISATA Hulst. Figs. 34, 57, 84, 117, 156, and 205.

Range: Southern British Columbia and Vancouver Island (Jones, 1951).

Host: *Juniperus scopulorum* Sarg.

Life History: Larvae feed in August and September; hibernation as pupae; adults in June and July.

Description: *Ultimate*: Head; cuticle rough, pale brown, with a few brown flecks on the parietals. Thorax and abdomen rough, green; M.D., fine, grey line; S.D., wavy, white stripe above and a grey supraspiracular stripe below; S.V., grey stripe (Fig. 156); prothoracic plate pale with brown

markings on middorsal line; anal plate brown, with a median furrow for entire length of plate; legs concolorous with body. Setae various, some short, others of moderate length and flattened at tip, mostly fine.

Measurements: H.W., 1.71 - 1.90 mm.; W/L, 1.71 - 1.84; B.L., 13 - 15 mm.; B.W., 2.0 - 3.0 mm.; annulets, 4 - 5; ventral proleg with 21 - 25 crochets in two groups; and 11 secondary setae. No. of larvae examined: 3.

Tribe Operophterini

OPEROPHTERA Hübner

Mature Larvae (Key to Species)

Larvae feed on *Quercus*, *Acer*, *Ulmus*, *Tilia*, and *Malus*; occurs in Nova Scotia.....*O. brumata*
Larvae feed on *Populus* and *Malus*; occurs across Canada.....*O. bruceata*

O. BRUCEATA Hulst. Figs. 16, 23, 55, 62, 82, 104, and 148.

Reference: de Gryse (1925).

Range: Transcontinental.

Hosts: *Populus tremuloides* Michx.; Forbes (1948): *Malus pumila* Mill., *Acer*.

Life History: Hibernates as egg; larvae hatch during first warm days of spring; when fully fed, larvae, which may be free-living, or may live in a shelter of leaves tied together, drop to the ground and pupate; after a severe frost or two the adults emerge in the fall (de Gryse, 1925).

Description: *Antepenultimate*: Head, thorax and abdomen, yellow. H.W., 0.52 mm. *Penultimate*: Head pale green with no markings; thorax and abdomen green with subdorsal stripe, supraspiracular line and broken subspiracular line, yellow. H.W., 0.86 mm.; B.L., about 10 mm.; B.W., 1.5 mm. *Ultimate*: Head: cuticle faintly reticulate, grey, pale green or russet-green; thorax and abdomen smooth, or almost smooth, pale green or green; M.D. and A.D., grey or green; there may be fine pale lines in the A.D., S.D., and L. regions. Setae long, brown, pointed.

Measurements: H.W., 1.36 - 1.50 mm.; W/L, 1.50 - 1.79; B.L., 15 - 20 mm.; B.W., 2.3 - 3.0 mm.; annulets, 4; ventral proleg with 18 - 30 crochets in one group and 4 secondary setae. No. of larvae examined: 12.

Remarks: "Vast areas of poplar woods in Alberta were completely defoliated in 1903 by these caterpillars, which occur quite commonly in that section of the prairies". (de Gryse, 1925).

Sporadically injurious to apple in British Columbia (Downing, Morgan, and Proverbs, 1956). Serious outbreaks have been reported in Vermont and Wisconsin (Craighead, 1950).

O. BRUMATA Linnaeus

References: Meyrick (1895); Stokoe and Stovin (1948); Cuming (1952).

Range: Nova Scotia (Reeks, Forbes, and Cuming, 1951).

Hosts: Reeks, Forbes, and Cuming, (1951): *Quercus*, *Acer*, *Ulmus*, *Tilia*, *Ostrya*; Cuming (1956): *Malus pumila* Mill., *Prunus*.

Life History: Overwinters in the egg; hatching occurs as soon as the leaves appear in the spring; larvae pass through five instars; pupation almost completed by last week in June; adults from October 23 until December 19 (Cuming, 1952; Ferguson, 1955a).

Description: *I.* H.W., 0.21 - 0.25 mm. *II.* H.W., 0.39 - 0.42 mm. *III.* 0.56 - 0.67 mm. *IV.* 0.88 - 1.05 mm. *V.* Head: cuticle faintly reticulate, grey, pale green or russet-green; thorax and abdomen smooth, or almost smooth, pale green or green; M.D., and A.D., grey or green; there may be fine pale lines in the A.D., S.D., and L. regions. Setae long, brown, pointed.

Measurements: H.W., 1.38 - 1.61 mm.; W/L, 1.38 - 1.67; B.L., 10 - 13 mm.;

B.W., 2.0 - 2.3 mm.; annulets, 4; ventral proleg with 18 - 22 crochets in one group and 4 secondary setae. No. of larvae examined: 7.

Remarks: This pest often causes severe defoliation of the host (Reeks, Forbes, and Cuming, 1951).

EPIRRITA Hübner. Figs. 17, 54, 64, 151, and 198.

E. AUTUMINATA OMISSA Harrison

Reference: Day (1915).

Range: "Newfoundland and Labrador, west to British Columbia, south to Pennsylvania, but very rare, if present at all, in New York. Eurasia." (Forbes, 1948).

Hosts: *Picea*, *Pseudotsuga menziesii* (Mirb.) Franco, *Abies*, *Alnus*, *Salix*, *Populus tremuloides* Michx.; Forbes (1948): *Tsuga*; Day (1915): *Vaccinium*.

Life History: Eggs hibernate; free-living larvae feed from March 20 to April 30 on Vancouver Island (Day, 1915) and from early June until late July in Alberta; adults in fall.

Description: *I.* Head brown; body sooty olive-green with no apparent markings. *Intermediate*: Larvae chrome-yellow with inconspicuous lines running length of body, B.L., 5 mm. *Ultimate*: Head: cuticle faintly reticulate, pale green; thorax and abdomen: cuticle, faintly reticulate, green to yellow-green; M.D., grey-green to dark grey; A.D., grey or green; white or yellow lines ventrad to Dorsal setae; L, green with white line in subspiracular position, S.V. dark grey or concolorous; A.V. and M.V., whitish-green. Setae long, pale brown, pointed.

Measurements: H.W., 1.70-2.00 mm.; W/L, 1.48-1.84; B.L., 17-25 mm.; B.W., 2.5-3.8 mm.; annulets, 4; ventral proleg with 18-35 crochets in one group and 4 secondary setae. No. of larvae examined: 17.

Tribe Mesoleucini

EAROPHILA Gumpenberg

E. VASILATA Guenée. Figs. 33, 107, and 150.

Reference: Dyar (1905a).

Range: "Quebec to Hudson Bay, south to New Jersey, and west to the Pacific", (Forbes, 1948); Nova Scotia (Ferguson, 1955a).

Host: *Rubus*.

Life History: Larvae free-living, (five instars), late June; probably hibernate as pupae; adults March to June.

Description: *I.* Head white ("testaceous" of Dyar, 1905a) with no markings. H.W., 0.35 mm.; B.L., 1.4-2.3 mm.; B.W., 0.35 mm.; crochets on ventral proleg, 10, in one group. *II.* Head shining light yellow; body white. H.W., 0.5 mm. *III.* Head shining ("ochraceous-luteous" of Dyar); body green from food, unmarked, the intersegmental regions white. H.W., 0.8 mm. *IV.* Head ("caramel luteous" of Dyar); body translucent green, intersegmental regions yellow. H.W., 1.1 mm. *V.* Head: cuticle slightly rough, green; thorax and abdomen, slightly rough, green, with faint, white lines. Setae long, pale brown, pointed.

Measurements: H.W., 1.50-1.67 mm.; W/L, 1.35-1.56; B.L., 20-30 mm.; B.W., 2.7-3.0 mm.; annulets, 5-6; ventral proleg with 14-23 crochets in one or two groups, and 9-10 secondary setae. Number of larvae examined: 7.

MESOLEUCA Hübner

Mature Larvae (Key to Species)

Width of head about 1.3 mm.; occurs in Alberta and British Columbia.....*M. gratulata*
Width of head from 1.5 to 1.9 mm.; occurs across Canada.....*M. ruficollata*

M. GRATULATA Walker. Figs. 31, 108, and 153.

Reference: Dyar (1903a).

Range: Alberta and British Columbia.

Host: *Rubus*.

Life History: Larvae have four instars. Adults in March, April and May (Jones, 1951).

Description: *I.* Head black, the colour diluted centrally; body pale yellow; prothoracic shield dusky "luteous". *II.* Head pale yellow; body green. *III.* Head pale testaceous; body translucent green; no shields; a narrow broken white subdorsal line, a narrow waved lateral line and subventral fold whitish (Dyar, 1903a). H.W., 0.9 mm. *IV.* Head: cuticle smooth or almost so; green. Thorax and abdomen smooth or nearly so; green, with fine white lines in Dyar's subdorsal, lateral, and substigmatal areas. Setae long, pointed, pale brown.

Measurements: H.W., 1.34 mm.; W/L, 1.60; B.L., 24 mm.; B.W., 2.2 mm.; annulets, 4; ventral proleg with 11-14 crochets in two groups and 13 secondary setae. No. of larvae examined: 1.

M. RUFICILLATA Guenée

Range: Transcontinental, Quebec to North Carolina, and west to British Columbia.

Host: *Rubus*.

Life History: Eggs laid from late June until early August in Alberta; eggs hatch in about 10 days; larvae free-living, feed through four stages from early July until late August or early September; hibernate as pupae; adults May to July.

Description: *I.* Head pale brown, with no markings. Thorax and abdomen pale green; setal bases black. H.W., 0.38-0.40 mm.; B.L., about 4 mm.; B.W., 0.4 mm. *II.* Head pale brown, with or without brown markings arranged in herring-bone pattern along epicranial stem and over side of head. Thorax and abdomen green or pale green, with suggestion of fine grey line at M.D. and fine, broken grey line at A.V. position. H.W., 0.65-0.67 mm.; B.L., 7-8 mm.; B.W., 0.5-1.1 mm. *III.* Head, green with black or brown specks arranged in a herring-bone pattern along the epicranial stem and over the sides of the head. Thorax and abdomen green; M.D., grey line; A.D. grey line on thorax and on posterior part of abdominal segments 1-5 inclusive; on abdominal segment 5, this line appears as a middorsal triangle of dull red colour, subspiracular line white and below the subspiracular on the thorax and at the base of the ventral proleg is a purple or red line; S.V., and M.V., white lines; venter pruinose. Setae long, brown, pointed. H.W., 0.97-1.04 mm.; B.L., 15 mm.; B.W., 1.14-1.30 mm. *IV.* Head, cuticle smooth, or nearly so; pale green, with brown markings arranged in herring-bone pattern along epicranial stem and on sides of head; in line with red line on thorax is brown subocellar line. Thorax and abdomen smooth, or almost so, green; M.D., dark green line; on abdominal segments 1-7, a red or brown triangular spot at the posterior edge of each segment; white subspiracular line; below subspiracular line on thorax and posterior abdominal segments is red line; venter pruinose; there may be fine white A.V. and M.V. lines. Prothoracic plate green; anal plate rose-coloured. Setae long, brown, pointed.

Measurements: H.W., 1.50-1.90 mm.; W/L, 1.43-1.55; B.L., 18-28 mm., B.W.,

1.9-2.7 mm.; annulets, 4; ventral proleg with 18-24 crochets in one or two groups, and 12-14 setae on side of leg. No. of larvae examined: 7.
 Remarks: Descriptions based on larvae reared from gravid females.

SPARGANIA Guenée.

Mature Larvae (Key to Species)

1. Larvae green, without any oblique dark markings on dorsum of abdomen 2
 Larvae pale brown or yellow, with a brown cross-like marking on each of the first seven abdominal segments (Fig. 18) *S. luctuata obductata*
2. Dark markings often in herring-bone pattern on pale green or brown head *S. magnoliata*
 No markings on the head *S. luctuata obductata*

S. MAGNOLIATA Guenée. Figs. 30, 80, and 149.

Reference: Dyar (1903b).

Range: Transcontinental. "Newfoundland to North Carolina, west to the Pacific." (Forbes, 1948).

Hosts: *Epilobium*, *Oenothera*.

Life History: Free-living larvae feed in August and September; (four instars); pupae hibernate; adults throughout summer.

Description: *I.* Head pale luteous; body white, unmarked. *II.* Head white with faint dusky marks on the sides of the lobes; body white, with a narrow diffuse, dusky green dorsal line; tracheal line white; a barely indicated pale subdorsal line. H.W., 0.6 mm. *III.* Head green, freckled with purplish; body green; subdorsal and lateral lines greenish-white; middorsal and lateral lines greenish-white; middorsal line dark-marked on posterior abdominal segments with purple-brown; a little purple shading on ventral proleg. H.W., 0.85 mm. *IV.* Head, cuticle slightly rough; green with fine brown flecks over the parietal lobes (these flecks may be arranged in herring-bone pattern). Thorax and abdomen slightly rough; green, yellow-green, or pale grey; M.D., green, or brown, or pale grey anteriorly and brown posteriorly; A.D. ventrad to Dorsal setae is fine grey or pale brown line; S.D. supraspiracular line geminate grey or brown; spiracles in pale brown areas; L, subspiracular stripe may be rose-coloured; S.V., may be brown; A.V., may be brown line; thoracic legs pale brown; prolegs pale brown or pale green; ventral proleg with two lines down it, a dark one anteriorly and a contrasting light one posteriorly. Setae of moderate length, pale brown, pointed.

Measurements: H.W., 1.34-1.52 mm.; W/L, 1.52-1.72; B.L., 18-30 mm.; B.W., 1.8-2.5 mm.; annulets, 6; ventral proleg with 14-28 crochets, in one or two groups, and 14 secondary setae. No. of larvae examined: 10.

S. LUCTUATA OBDUCTATA Moeschler. Fig. 18.

References: Haggett (1952, 1954); Hoffmeyer (1952), as *Euphyia luctuata* Schiff.; Hare (1953).

Range: Holarctic. Labrador to southern Maine and west to the Pacific.

Host: *Epilobium*.

Life History: Eggs laid in early summer; 10-20 days incubation; larvae free-living, feed in four instars, from early July until late September; hibernation in pupal stage; adults in June and July.

Description: *I.* Head, thorax and abdomen, pale yellow. H.W., 0.34 mm.; B.L., 5.00 mm. *II.* Head pale russet with no markings; thorax and abdomen pale russet with no lines. H.W., 0.56-0.67 mm.; B.L., about 6.5 mm.; B.W., 0.6 mm. *III.* Head yellow-green with no markings; thorax and abdomen pale green; grey-green M.D. line; S.D. line, yellow-green or white; lines

in spiracular region yellow-green. H.W., 1.02-1.14 mm.; B.L., about 15 mm.; B.W., about 1.5 mm. IV. Cuticle of head, thorax and abdomen, slightly rough. There are two colour forms in this, the final instar: green and brown. Hoffmeyer (1952), Hare (1953), and Haggett (1954) report both forms in the Danish and British faunas. Green form: head, pale russet-green; thorax and abdomen yellow-green; M.D., greyed yellow-green line; S.D., yellow line near Dorsal setae; L., green spiracular line; M.V., pale line. Brown form: head, pale brown, with brown markings in herring-bone pattern on parietal lobes; thorax and abdomen, yellow or pale brown; M.D., brown line, with brown cross on each of abdominal segments 1-7; S.D., geminate brown line near Dorsal setae; A.V., and M.V., grey stripes flank pale M.V. line; plates and legs concolorous with body (Fig. 18). Setae of moderate length, pale brown, pointed.

Measurements: H.W., 1.54-1.67 mm.; W/L, 1.50-1.67; B.L., 20-25 mm.; B.W., 2.0-2.6 mm.; annulets, 5; ventral proleg with about 18 crochets in two groups, and 14 secondary setae. No. of larvae examined: 10.

Remarks: In each of two cases, the writer obtained larval offspring of both colours from the same female. The forms appeared in a one to one ratio.

Hydriomenini

CALOCALPE Hübner

Mature Larvae (Key to Species)

- Larvae solitary; thoracic legs dark brown or black (at least in part); width of head varies from 1.67 to 1.75 mm.; W/L ratio varies from 1.67 to 1.82; larvae feed on *Rhododendron canadense*, *Spiraea*, *Azalea*, *Salix*, and *Populus*; Holarctic....*C. undulata*
 Larvae gregarious; thoracic legs pale, concolorous with ground colour; width of head varies from 1.58 to 1.67 mm.; W/L ratio varies from 1.55 to 1.58; larvae feed on *Prunus serotina*; eastern North America.....*C. prunivorata*

C. UNDULATA Linnaeus. Fig. 26.

References: Packard (1890); Ferguson (1955b).

Range: Holarctic. Quebec to North Carolina, west to the Pacific (Forbes, 1948).

Hosts: *Salix*, *Populus*; Ferguson (1955b): *Rhododendron canadense* (L.) Torr., *Spiraea*, *Azalea*.

Life History: Larvae, feed singly in a slight web, in late summer and fall; pupae hibernate; adults in June and July.

Description: *Ultimate*: Head, cuticle smooth, shiny orange-brown to brown, often with dark brown or black markings laterally and dorsally; thorax and abdomen smooth, dull green, or grey-yellow, or deep flesh colour; M.D., and A.D., slightly darker lines than ground colour; S.D., brown stripe, not always very prominent; venter and sides yellow or reddish flesh colour. Packard (1890) records two broad lateral dark reddish-brown supraspiracular lines. Setae long, brown, pointed.

Measurements: H.W., 1.67-1.75; W/L, 1.67-1.82; B.L., about 20 mm.; B.W., 3.0 mm.; annulets, 4-5; ventral proleg with about 24 crochets in one group, and 4 secondary setae. No. of larvae examined: 5.

C. PRUNIVORATA Ferguson. Fig. 141.

References: Packard (1890); Dyar (1900a); Ferguson (1955b).

Range: Eastern North America (Ferguson, (1955b).

Host: *Prunus serotina* Ehrh.

Life History: Larvae in four instars feed in groups in a shelter of leaves tied together in late summer and fall; hibernate as pupae; moths fly May 14 to

Sept. 3, with two broods overlapping in the south; probably one brood in north (Ferguson, 1955b).

Description: *I.* Head pale yellow, no marks; body ochrous yellow, anal plate and anal leg plates dusky. H.W., 0.3 mm. *II.* Head pale yellow; body yellow, a broad shaded subdorsal, black band and a faint, narrower, dorsal one. H.W., 0.5 mm. *III.* Head shining reddish-orange; body pale green with dorsal, addorsal, and subdorsal broad, black lines, with only narrow spaces between, the subdorsal broadest, and edged with whitish below. H.W., 1.1 mm. (Line names of Stages I, II, and III, are taken from Dyar, 1900a). *IV.* Head, cuticle smooth, orange-brown to reddish-orange; thorax and abdomen smooth, yellow-green; M.D., A.D., and S.D., dark brown, the latter the widest; sides and venter ground colour (Fig. 141). Setae long, brown, pointed.

Packard's description (1890) differs from this: body dull black, with four equidistant, much-broken yellow hair-lines, being so many rows of fine dots. Lower and under side bright straw-yellow, with broken interrupted dusky lines. A longitudinal black band along the base of the legs. Anal plate black.

Measurements: H.W., 1.58-1.67 mm.; W/L, 1.55-1.58; B.L., 20-22 mm.; B.W., about 2.0 mm.; annulets, 4-5; ventral proleg with 26-28 crochets in one group, and 4 secondary setae. No. of larvae examined: 3.

CORYPHISTA Hulst

C. MEADI Packard. Figs. 53, 87, 106, and 142; MacKay (1954).

References: Dyar (1902b); Neiswander (1941); Hardy (1954b); MacKay (1954).

Range: In Canada, discontinuous; *C. meadi* occurs in southern British Columbia and the Cordilleran Region of Alberta; *C. meadi atlantica* occurs sporadically in Eastern Canada (Munroe, 1954); in United States, from Central New York to South Carolina, and west to the Pacific (Forbes, 1948).

Host: *Berberis*.

Life History: Egg stage from 3-7 days; free-living larvae feed about 14 days and pupate; about 11 days spent in pupal stage unless pupation occurs in fall; hibernate as pupae; adults April to August.

Description: *I.* Head and body cream or pale yellow; H.W., 0.29 mm. (MacKay, 1954) and 0.4 mm. (Dyar, 1902b); B.L., about 2.2 mm.; crochets in one group, number about 16 on ventral and 17 or 18 on anal proleg. *II.* Head pale pink or flesh colour; body olivaceous-green, a fine addorsal white line and a broad subdorsal olive-grey band; subspiracular stripe white; venter dusky. H.W., from approximately 0.64 to 0.70 mm.; B.L., about 10 mm. *III.* Head pale red, yellow in sutures; body black with fine pale lines on dorsum; spiracular area white, sometimes yellow around spiracles; H.W., about 1.11 mm.; B.L., about 14 mm. *IV.* Head, cuticle, smooth, orange to light yellow-orange with no pattern. Thorax and abdomen, slightly roughened, pale; dorsum divided by fine, light lines into 5 dark brown stripes; L., spiracular area white or light-coloured, with brown or black areas at intersegments; the white spiracular stripe extends on to the anal proleg; venter brown or black; M.V., pale line (Fig. 142); prothoracic shield almost black, crossed by a narrow middorsal line of white, and the narrow lateral lines; anal shield black; thoracic legs brownish-yellow; prolegs with dark plates, the one on the anal, black, divided by the white spiracular line. Setae long, brown, pointed.

Measurements: H.W., 1.87-2.08 mm.; W/L, 1.60-1.79; B.L., 20-26 mm.; B.W., 2.0-3.0 mm.; annulets, 4; ventral proleg with 26-34 crochets in one group, and 4 secondary setae. No. of larvae examined: 10.

Remarks: From one female Hardy (1954b) obtained 75 eggs; from these 57 adults were reared: 29 were typical *C. meadi* and 28 were of the form *badiaria* Henry Edwards, with no intermediate grades. Sexes were indiscriminately distributed among the two forms, with males predominating.

This insect is sometimes an important pest of barberry (Neiswander, 1941).

RHEUMAPTERA Hübner

R. HASTATA Linnaeus, *R. SUBHASTATA* Nolcken, and *R. ALBODECORATA* Blackmore
References: Stokoe and Stovin (1948); Forbes (1948); and Craighead (1950).

Range: There is some confusion about the nearctic components of this genus but, if there are three species, as eastern (Forbes, 1948); Ferguson, 1955a) and western lists (Bowman, 1951; Jones, 1951) indicate, it seems likely *R. hastata* is a transcontinental feeder, primarily on *Betula* and secondarily on *Salix* and *Alnus*, *R. subhastata* is an eastern feeder on *Myrica* (Ferguson, 1955a), and *R. albodecorata* is a western feeder on *Alnus*.

Hosts: *Betula*, *Alnus*, *Salix*, *Myrica*.

Life History: Eggs laid in early summer; about 7 days in egg stage; larvae feed in shelter of leaves tied together; about three weeks in larval stage; hibernate as pupae; adults in June and July.

Description: *Ultimate*: Head, cuticle, slightly rough, brown. Thorax and abdomen smooth, or almost smooth; dark brown to black; may be four, fine pale lines on dorsum and pale markings in spiracular area. Setae long, pale brown, pointed. (The writer has seen more than 50 alder-feeding larvae and a small number of birch-feeders that fit this description. These larvae are much like those of Forbes' (1948) description of *R. hastata*). A few larvae, lighter in appearance than the others, and with prominent lines, have been reared by the writer from eggs laid on birch; these may be like those described by Stokoe and Stovin (1948).

Measurements: H.W., 1.50-2.20 mm.; W/L, 1.39-1.48 mm.; B.L., 14-20 mm.; B.W., 2.0-3.0 mm.; annulets, 6-8; ventral proleg with 20-22 crochets in one group, and 4 secondary setae. No. of larvae examined: 62.

TRIPHOSA Stephens

T. AFFIRMARIA Walker. Figs. 28 and 152.

Range: "Labrador to North Carolina, west to the Pacific" (Forbes, 1948).

Hosts: Forbes (1948): *Rhamnus* and *Prunus*; D. Evans (*in litt.*) principally *Rhamnus*, but also *Pseudotsuga menziesii* (Mirb.) Franco and occasionally *Quercus*.

Life History: Eggs probably laid in spring; larvae from middle of May until middle of July, occasionally until end of September; pupal period, about 24 days; adults hibernate in mid-winter and fly in all, or nearly all, the other months in southern British Columbia (D. Evans, *in litt.*, and Jones, 1951).

Description: *Ultimate*: Head, cuticle smooth, pale russet-green. Thorax and abdomen smooth, green; two fine lines on each side of dorsum; supra-spiracular stripe whitish-yellow; venter white or pale grey. Setae long, pale brown, pointed.

Measurements: H.W., 1.90-1.93 mm.; W/L, 1.62-1.74; B.L., 20-25 mm.; B.W., 3.0-5.0 mm.; annulets, 4; ventral proleg with 32-36 crochets, in one group, and 4 secondary setae. No. of larvae examined: 4.

HYDRIOMENA Hübner

Mature Larvae (Key to Species)

1. A dark rectangle on middorsum of each anterior abdominal segment (Figs. 143-145)... 2
No dark rectangle on middorsum of each anterior abdominal segment (Figs. 139-140)... 5
2. Larvae feed on conifer foliage... 3
Larvae feed on angiosperm foliage... 4
3. Larvae with a dusky band across the venter (Fig. 143); crochets of ventral proleg number 30 to 40. *H. divisaria*
Larvae with no dusky band across the venter (Fig. 140); crochets of ventral proleg number 55 to 60. *H. albimontanata*
4. Larvae feed on *Quercus garryana* from April to June; occurs along the Pacific coast from British Columbia to California. *H. nubilofasciata*
Larvae feed on *Alnus* in August and September; occurs across the continent from the Atlantic to the Pacific. *H. renunciata*
5. Middorsal line of almost uniform width; subdorsal and spiracular stripes conspicuous (Figs. 14 and 139); larvae feed in spring and early summer on angiosperm foliage *H. furcata*
Middorsal line of varying widths; subdorsal and spiracular stripes lacking (Figs. 13 and 140); larvae feed on conifer foliage *H. albimontanata*

Notes on two additional species, *H. macdunnoughi* Swett, and *H. sp. poss. nevadae* B. and McD., have been included. These have been reared to adult stage on willow, and lodgepole pine, respectively, by the writer. There are also brief biological and descriptive notes on several species found in British Columbia (Ross and Evans, 1956b).

H. DIVISARIA Walker. Figs. 15 and 143; McGuffin (1942).

References: McGuffin (1942); McDunnough (1954).

Range: Transcontinental. "In the United States, it occurs in the northern Atlantic and New England states, ranging westward to Indiana and Michigan, and will probably be found in Wisconsin and Minnesota." (McDunnough, 1949); in Canada it may be found throughout the Coniferous Forest Formation (of Munroe, 1956), with the exception of Vancouver Island.

Hosts: *Picea*, *Abies*, *Larix*, *Pinus*, and *Pseudotsuga menziesii* (Mirb.) Franco.

Life History: Larvae often spin a frail shelter and feed throughout the latter part of the summer; hibernation in pupal stage; adults mid-June until early July.

Description: *Ultimate*: Head, cuticle very slightly roughened; light brown with brown markings in a herring-bone pattern on the parietals. Thorax and abdomen slightly rough, pale grey, often suffused with pink on anterior half of each abdominal segment; M.D., dark grey, broadened on first six or seven abdominal segments to form rectangular grey patches; L, supra-spiracular line dark grey; subspiracular line broken, ruddy brown; SV, AV and MV, ground colour, with pink suffusion in SV area (Figs. 15 and 143). Setae long, brown, pointed.

Measurements: H.W., 1.50-2.00 mm.; W/L, 1.29-1.51; B.L., 10-18 mm.; B.W., 1.4-1.5 mm.; annulets, 4; ventral proleg with 30-40 crochets in one group, and 12-17 secondary setae. No. of larvae examined: 10.

H. FURCATA Borgstrom. Figs. 14, 21, 49, 71, 83, 85, 86, 88, 105, 122, 126, 139, 196, 197, 200, and 214.

Reference: Stokoe and Stovin (1948).

Range: Holarctic; transcontinental in North America, from Nova Scotia (Ferguson, 1955a) to Alaska and California (McDunnough, 1954).

Hosts: *Salix* generally but occasionally feeds on *Alnus*, *Prunus*, *Populus*, and *Betula*.

Life History: Hibernation, apparently, in egg stage; larvae, which often feed in small groups in shelters of leaves tied together, occur from time willow buds open until early July; pupal stage takes 15-25 days; adults in July and August east of Rocky Mountains; west of the mountains adults from March until August (Jones, 1951).

Description: *Ultimate*: Head, cuticle very slightly roughened; brown, with dark brown markings arranged in herring-bone pattern on parietals; thorax and abdomen slightly rough; ground colour red; M.D., brown or black stripe of about same width throughout length; S.D., white line ventrad to Dorsal setae, then pale brown stripe, then a fine pale line; spiracular stripe is pale brown below and dark brown or black above; L, subspiracular line pink or pale brown; S.V., A.V., and M.V., pale brown or pink lines that are usually absent (Fig. 139); prothoracic shield conspicuous, brown, with white lines in line with pale lines on dorsum (Figs. 14 and 139); anal shield brown with dark brown pits; thoracic legs brown; prolegs rosy. Setae long, brown, pointed.

Measurements: H.W., 1.61-1.84 mm.; W/L, 1.48-1.72; B.L., 12-20 mm.; B.W., 2.0-3.0 mm.; annulets, 5-6; ventral proleg with 34-44 crochets in one group, and 14-18 secondary setae. No. of larvae examined: 10.

H. NUBILOFASCIATA Packard. Fig. 145.

Reference: Hardy (1951).

Range: Along the Pacific Coast, from Vancouver Island, British Columbia, to California (MacDunnough, 1954).

Host: *Quercus garryana* Dougl.

Life History: Eggs laid March 26, 1949. Eclosion began April 17; larvae feed concealed, at first in the bud and later between leaves tied together; pupation began May 21; hibernation in pupal stage (Hardy, 1951); adults in February and March (Jones, 1951).

Description: *I*. Head black, body dull green. B.L., 1.0 mm. *Intermediate*: Nine days after hatching, larvae with black heads and fuscous-brown bodies. B.L., 4 mm. Two weeks after hatching, larvae had brown heads with black flecks; body dull black with three indefinite longitudinal dorsal lines of small beige-coloured spots. B.L., 8.0 mm. *Ultimate*: Head, slightly rough; light brown. Thorax and abdomen slightly rough, pale green with interrupted dusky dorsal and lateral lines (Fig. 145). Setae long, brown, pointed.

Measurements: H.W., 2.05-2.20 mm.; W/L, 1.47-1.53; B.L., 20-24 mm.; B.W., about 2.5 mm.; annulets, 4; ventral proleg with 45-50 crochets in one group and 19 secondary setae. No. of larvae examined: 2.

H. RENUNCIATA Walker. Fig. 144.

Reference: Ross and Evans (1956b).

Range: Transcontinental; probably generally distributed throughout the northern Atlantic and New England states, across Canada, and in the north-western states, where the larval food plant, *Alnus*, grows.

Host: *Alnus*.

Life History: Larvae feed in August and September in shelters, formed by folding over the edge of the leaf and tying this with silk; hibernation in pupal stage; adults late May to early July.

Description: *Ultimate*: Head, cuticle very slightly roughened; brown, with dark brown markings arranged in herring-bone pattern on parietals; thorax and abdomen slightly rough, ground colour pale brown; M.D., grey brown line,

in some larvae the line is widened into rectangles; venter unmarked. Some larvae have very little pattern and others resemble *H. divisaria* (Figs. 143 and 144). Setae long, brown, pointed.

Measurements: H.W., about 1.67 mm.; W/L, 1.43-1.50; B.L., 13-18 mm.; B.W., 1.7-2.7 mm.; annulets, 5; ventral proleg with 35-40 crochets in one group, and 13-15 secondary setae. No. of larvae examined: 3.

H. ALBIMONTANATA McDunnough. Figs. 13 and 140.

Reference: Ross and Evans (1956b).

Range: "Eastern Arizona, extending northward through the Rocky Mountains to Alberta and southeast and central British Columbia". (McDunnough, 1954).

Hosts: *Pseudotsuga menziesii* (Mirb.) Franco, *Picea*.

Life History: Larvae feed in slight silken shelter in August and September; pupae hibernate; adults in June.

Description: *Penultimate*: Head, brown; body rose-coloured with a yellow spiracular line. H.W., 1.52-1.62 mm.; B.L., 10-13 mm.; B.W., 1.2-2.0 mm.

Ultimate: Head cuticle very slightly roughened; brown, with dark brown markings arranged in herring-bone pattern on parietals; thorax and abdomen slightly rough, rose-coloured or yellow with rose suffusion; M.D., dark brown line, and may broaden out to form rectangles on the anterior abdominal segments; S.D., supraspiracular line brown at intersegmental regions (Figs. 13 and 140); prothoracic plate brown, flanked by pale brown on the sides; anal plate rose-coloured anteriorly and pale brown posteriorly. Setae long, brown, pointed.

Measurements: H.W., 1.90-2.10 mm.; W/L, 1.29-1.51; B.L., 18-20 mm.; B.W., about 2.0 mm.; annulets, 5; ventral proleg with 55-60 crochets, and 16 secondary setae. No. of larvae examined: 4.

H. MACDUNNOUGH SWETT.

Range: "Appears to be confined to the Hudsonian zone of the Rocky Mountain region," (McDunnough, 1954).

Host: *Salix*.

Life History: Larvae feed in August and September; hibernate as pupae; adults in June.

Description: *Ultimate*: Head pale grey with much dark grey marking, arranged in herring-bone pattern, on parietal lobes. Thorax and abdomen pale grey; M.D., dark grey stripe; much dark grey on sides and dorsum. Venter, pale purplish-grey; thoracic and anal plates concolorous with thorax and abdomen. Setae long, pale brown, pointed.

Measurements: H.W., about 1.40 mm.; B.L., 12 mm.; B.W., 1.2 mm. No. of larvae examined: 1.

Remarks: The description and measurements were based on one larva, Forest Insect Survey Record No. 1948 Alberta 417 J, from Leyland, Alberta. This larva developed into a male.

H. SP. POSS. NEVADAE Barnes and McDunnough.

Range: Western North America (McDunnough, 1954).

Host: *Pinus contorta latifolia* Engelm.

Life History: Larva in September; hibernates as pupa; adults of *H. nevadae* in June (Jones, 1951).

Description: *Ultimate*: Head, pale brown with brown herring-bone markings

along the epicranial stem and on the sides of the head. Thorax and abdomen pale brown; M.D., a brown line widened into a patch, roughly rectangular in shape, on each of abdominal segments 1-7 inclusive; L., spiracular is pale brown stripe; subspiracular, brown area; venter, pale brown.

Measurements: H.W., about 1.90 mm.; B.L., 13-18 mm.; B.W., 2.0 mm. No. of larvae examined: 1.

Remarks: The description and measurements were based on one larva, Forest Insect Survey Record No. 1954 Alberta 2077A, Carrot Creek, Banff National Park, Alberta; this larva developed into a female.

H. IRATA Swett.

Reference: Ross and Evans (1956b).

Range: Pacific coastal area from Alaska to California (McDunnough, 1954).

Hosts: Ross and Evans (1956b): *Picea*, *Tsuga*, *Pseudotsuga menziesii* (Mirb.) Franco.

Description: *Larva*: Pale brown head and anal plate; early instars banded with reddish-brown or drab green; later instars with dark broken subdorsal and spiracular lines.

H. SPECIOSATA Packard.

Reference: Ross and Evans (1956b).

Range: California, Washington, and Vancouver Island, British Columbia (McDunnough, 1954).

Hosts: Ross and Evans (1956b): *Pinus contorta* Dougl., *Pseudotsuga menziesii* (Mirb.) Franco, *Tsuga heterophylla* (Raf.) Sarg.

Description: *Larva*: Head dark brown; body pale brown, brighter on sides; irregular dark dorsal and lateral lines.

H. MANZANITA Taylor.

Reference: Ross and Evans (1956b).

Range: Pacific coast region from Vancouver Island, British Columbia, to central California (McDunnough, 1954).

Host: Ross and Evans (1956b): *Arbutus menziesii* Pursh.

Description: *Larva*: Head and body greenish-yellow; fine grey lines on dorsum.

EUPHYIA Hübner

No key has been prepared to separate these three species of *Euphyia* but it may be convenient to do this by food-plant preference.

E. MULTIFERATA Walker. Figs. 29, 169, and 209.

Reference: Dyar (1903c).

Range: Transcontinental; Nova Scotia, Quebec, and west to the Pacific, north to the Yukon (Forbes, 1948).

Host: *Epilobium*.

Life History: Larvae, in four instars, feed in July; probably hibernate as pupae; adults in May and June.

Description: *I*. Head yellowish-white, with smoky brown dots on the lobes; thorax and abdomen pale yellow; dorsal and subdorsal, purple-brown lines of varying widths; traces of an addorsal line which curves outwardly on abdominal segment 8; broken lateral, subventral, and adventral lines; no shields. *II*. Head pale white dotted with brown; body pale with red-brown lines; traces of addorsal line, broken subdorsal, lateral, subspiracular, sub-

ventral and midventral lines. H.W., 0.5 mm. *III.* Head white with black dots on face; body much as in *II.* H.W., 0.9 mm. *IV.* Head, cuticle, finely reticulate, white with broad brown stripe on upper angles of the parietals. Thorax and abdomen finely reticulate or smooth, green; prothoracic shield yellow, with brown blotches; from the prothoracic shield a broad dorsal band runs backward to fade out on abdominal segment 2 and reappear as dashes on the anterior part of segments 9 and 10. Setae moderately long, brown, pointed.

Measurements: H.W., 1.25 - 1.50 mm.; W/L, 1.39; B.L., about 20 mm.; B.W., about 1.5 mm.; annulets, 6; ventral proleg with 10-12 setae in two groups, and 5 secondary setae. No. of larvae examined: 3.

E. LACTEATA Packard

Reference: Hardy (1954a).

Range: British Columbia.

Host: *Montia*.

Life History: Eggs laid April 10; larvae (five instars), from April 22 - June 1; hibernation in pupal stage; adults late February to early May.

Description: *I.* Head pale brown; body translucent grey. B.L., 1 mm. *II.* Head pale brown; body translucent green; some larvae are red in colour. B.L., 5 - 6 mm. *III.* Head pale brown; body pale green with dark dorsal green stripe; some larvae have faint white dorsal and subdorsal lines. B.L., 8 - 10 mm. *IV.* Head pale brown dotted with light brown flecks; body jet black with four white interrupted lines that take the form of dash-like marks at the juncture of the segments. B.L., 15 mm. *V.* Head pale brown with small brown dots and an irregular V-shaped brown mark on upper part of head; body dark fuscous to light grey-brown or buff with a broad, black dorsal stripe edged with pale yellow; two thin black lines between the dorsal and the spiracular lines; venter light grey with four fuscous longitudinal lines interrupted on each segment by the ground colour, thus giving the appearance of a chain of dashes. B.L., 23 mm.

E. IMPLICATA Guenée

Reference: Comstock (1939).

Range: California.

Host: *Abronia umbellata* Lam.

Life History: Larvae, leaf miners in early instars and free living in late instars; adults throughout the year; probably several generations.

Description: *Early instar:* Head black; body green. *Ultimate:* Head rose-pink, heavily sprinkled with dots of straw-yellow, light brown, and olive. Thorax and abdomen rose-pink, heavily sprinkled with dots of straw-yellow, light brown, and olive; no lines or bars; thoracic legs straw-yellow, shading to brown at tips; prolegs concolorous with body.

DIACTINIA Warren

D. SILACEATA Hübner and *D. SILACEATA ALBOLINEATA* Packard. Figs. 43, 111, and 172.

References: Stokoe and Stovin (1948), as *Ecliptopera*, and Hoffmeyer (1952), as *Euphyia*.

Range: The typical species is holarctic.

Hosts: *Epilobium*; Hoffmeyer (1948): *Impatiens*.

Life History: (*D. silaceata albolineata*). Egg stage, 5 - 6 days; free-living larvae, in four instars, feed for about 30 days; overwintering as pupae; adults June - August.

Description: (*D. silaceata albolineata*). *I.* Head brown; body pale green. H.W., 0.38 mm. *II.* Head pale brown; body pale green anteriorly and pale yellow posteriorly. H.W., ?; B.L., 13 mm.; B.W., 0.76 mm. *III.* Head pale brown; body pale green; M.D., fine blue-green line anteriorly and rose-coloured stripe posteriorly; fine white line in subdorsal region; spiracular and midventral lines fine, pale. H.W., 0.86 - 1.00 mm.; B.L., about 20 mm.; B.W., about 1.1 mm. *IV.* Head, cuticle, finely reticulate, pale russet-green or pale brown, with reddish-brown or dark brown patch on each side of head, extending almost from occiput to the ocellar area and base of antenna; clypeus ground colour in middle, may be brown at apex or edges; antennae yellow. Thorax and abdomen finely reticulate; pale yellow or pink; M.D., grey-green or dark brown line, becoming broad stripe on posterior abdominal segments; pink lines ventrad of Dorsal setae and in supraspiracular positions; S.V., yellow-green or pink, or geminate brown; A.V., yellow-green, or pink, or dark brown; M.V., yellow-green, or pink, or pale grey line; thoracic and anal plates, concolorous with dorsum; thoracic legs pink; prolegs pale pink or green; anal prolegs with dark and light lines along them. Setae moderately long, brown, pointed, from prominent white papillae.

Measurements: H.W., 1.34 - 1.52 mm.; W/L, 1.45 - 1.60; B.L., 24 - 31 mm.; B.W., 1.7 - 2.0 mm.; annulets, 8 - 9; ventral proleg with 12 - 15 crochets in two groups and 6 secondary setae. No. of larvae examined: 7.

EUSTROMA Hübner

E. SEMIATRATA Hulst. Figs. 39 and 161.

Reference: Dyar (1904a).

Range: Nearctic.

Host: Dyar (1904a): *Epilobium*.

Life History: Adults July-September in New York (Forbes, 1948) and April-October in British Columbia (Jones, 1951).

Description: *I.* Head pale white with numerous black dots. Body white, with a broad grey subdorsal band; subventral and midventral lines grey. *II.* Head white, thickly checkered with black, leaving a pale streak on lobe above. Body grey or greenish-white with waved brown lines in M.D., S.D., L., and S.V., areas. H.W., 0.6 mm. *III.* Head white with black angular dots along epicranial suture and on sides of head. Body grey from black lines overlaid on a white ground; dorsal line narrow, dark; subdorsal and lateral lines wavy, white; subventer and venter with broad pale lines. H.W., 0.85 mm. *IV.* Head, cuticle reticulate; white with black or brown markings arranged in a herring-bone pattern along the epicranial stem and over each side of the head; clypeus pale with dark brown dots. Thorax and abdomen, slightly rough, grey, dorsum and sides mottled with brown. Setae long, pale brown, pointed.

Measurements: H.W., 1.30 - 1.40 mm.; W/L, 1.29 - 1.30; B.L., 24 - 28 mm.; B.W., 1.8 - 2.0 mm.; annulets, 4; ventral proleg with 12 - 13 crochets in two groups and 5 secondary setae. No. of larvae examined: 2.

LYGRIS Hübner

Key to Species (Mature Larvae)

1. Head with parietal lobes attenuate; on *Vitis* and *Parthenocissus* 2
 Head normal; larvae with other food plants 3
2. Larvae green *L. diversilineata*
 Larvae brown *L. gracilineata*
3. Middorsal and midventral lines partially merged with addorsal and adventral lines, respectively, on abdominal segment 3 (Fig. 166) *L. xyliana*
 Middorsal and midventral lines not merged with addorsal and adventral lines, respectively, on abdominal segment 3 (Figs. 162 - 165) 4
4. Dark line bearing both setae D is continuous and straight on abdominal segment 3 (Fig. 163); may be no lateral swelling on mesothorax *L. testata*
 Dark line bearing either seta D-1 or D-2 is neither continuous nor straight on abdominal segment 3; lateral swelling on mesothorax 5
5. Oblique dash anterior to seta D-1 on abdominal segment 3 (Figs. 164 and 165); larvae feed on *Salix* and *Populus* 6
 No oblique dash anterior to seta D-1 on abdominal segment 3 (Fig. 162); larvae feed on *Ribes* *L. propulsata*
6. A continuous dark line through seta SV-3 (Fig. 165); subalpine in Alberta *L. destinata*
 Little or no dark line through seta SV-3 (Fig. 164); on plains in Alberta *L. flavibrunneata*

L. DIVERSILINEATA Hübner

Reference: Craighead (1950).

Range: Gaspé, Quebec, to Florida, and west to Alberta, Colorado, and California (Forbes, 1948; Bowman, 1951).

Hosts: *Vitis*, *Parthenocissus*.

Life History: Larvae free-living; feed from May until the middle of July in eastern Canada; pupation takes about 10 days; adults fly in late July and August; hibernate in egg (Craighead, 1950).

Description: *Ultimate*: Head, cuticle, reticulate; horned or bifid; yellow, with green tint. Thorax and abdomen reticulate; yellow-green; M.D., fine purple, on first two abdominal segments; M.V., purple line on abdominal segments 2 to 6 inclusive; mesothorax swollen on side into a brown protuberance. Setae, short, brown, pointed.

Measurements: H.W., 1.84 mm.; W/L, 1.57; B.L., 38 mm.; B.W., 2.0 mm.; annulets, 7; ventral proleg with 18 crochets in two groups, and 5 secondary setae. No. of larvae examined: 1.

L. GRACILINEATA Guenée

Range: Nova Scotia, to Florida, and west to Saskatchewan (Forbes, 1948).

Hosts: *Vitis*, *Parthenocissus*.

Life History: Unknown.

Description: *Ultimate*: Head, cuticle reticulate, horned or bifid, pale brown with brown dots. Thorax and abdomen, reticulate, pale brown with traces of brown lines on sides; brown swelling on side of mesothorax; M.D., brown line; M.V. brown line. Setae short, brown, pointed.

Measurements: H.W., 1.75 - 1.84 mm.; W/L, 1.47 - 1.50; B.L., about 30 mm.; B.W., about 2.0 mm.; annulets, 5 - 6; ventral proleg with about 15 crochets in two groups, and 5 secondary setae. No. of larvae examined: 2.

L. PROPULSATA Walker. Figs. 40, 52, 63, 89, 90, 109, and 162.

Range: Nova Scotia and Quebec, to mid-Pennsylvania, west to the Pacific (Forbes, 1948).

Host: *Ribes*.

Life History: Probably hibernate as egg; larvae, free-living, (four instars), late May to July 19 in western Canada; pupal period from 7 - 18 days; adults June to August.

Description: *I*. Head pale grey; thorax and abdomen pale grey; middorsal stripe dark grey; subdorsal stripe grey; yellow spiracular stripe; subventral stripe dark grey; venter pale with very fine dark midventral line. H.W., about 0.3 mm.; B.L., 3.6 mm.; B.W., 0.4 mm. *II*. Head pale grey with dark grey markings in lines over parietal lobes; thorax and abdomen pale grey; middorsal line dark, somewhat as in Fig. 162; posterior triangle white, prominent; pattern of dorsum and sides dark grey; subspiracular line curved under spiracles, dark grey; subventral line geminate; midventral line broken, dark brown or grey. H.W., 0.63 mm.; B.L., 7 mm., B.W., 0.8 mm. *III*. Head pale yellow or pale brown with brown markings arranged in herring-bone pattern along epicranial stem and over parietal lobes; thorax and abdomen pale yellow or grey; pattern much as in second instar. H.W., 0.98 - 1.14 mm.; B.L., 15 - 20 mm.; B.W., 1.0 - 1.5 mm. *IV*. Head, cuticle, reticulate; pattern as in third stage. Thorax and abdomen, reticulate; pale grey or pale brown; M.D., dark brown or grey, broken with conspicuous white triangle at posterior edge of anterior abdominal segments (Fig. 162); S.D., pale stripe from anterior edge of segment to seta SD-1, flanked by dark lines; sides brown, in various shades; M.V., dark brown, broken line; thoracic plate concolorous with body; anal plate pale brown, dotted with dark brown pits and a dark brown groove extending two-thirds the distance to the posterior end of the plate; legs brown, the anal proleg has a light bar down anterior aspect. Setae short to moderate in length, brown, pointed.

Measurements: H.W., 1.52 - 1.71 mm.; W/L, 1.42 - 1.59; B.L., 18 - 30 mm.; B.W., 2.0 - 3.0 mm.; annulets, 5 - 6; ventral proleg with 20 - 30 crochets, in two groups, and 5 secondary setae. No. of larvae examined: 7.

L. TESTATA Linnaeus. Fig. 163.

Reference: Stokoe and Stovin (1948).

Range: Holarctic; transcontinental in North America, south to New Jersey (Forbes, 1948).

Hosts: *Betula*, *Ribes*, *Populus*, *Alnus*, *Salix*.

Life History: Larvae free-living, early June - early August; about 11 days spent in pupal stage; adults August and September.

Description: *I*. H.W., 0.56 mm. (possibly second instar). *II*. H.W., 0.81 mm. *III*. Head pale grey with black or brown dots in herring-bone pattern on parietal lobes; clypeus with four brown spots, two in upper and one in each lower corner. Thorax and abdomen pale grey, with fine black M.D. line, red-brown A.D. and S.D. lines; oblique markings on sides; red-brown lines in ventral region; M.V., fine red-brown line. H.W., 1.19 mm.; B.L., 15 mm.; B.W., 1.0 mm. *IV*. Head, cuticle reticulate; pattern much as in third stage. Thorax and abdomen reticulate, pale grey; M.D., dark brown; M.V., fine brown line; other lines in brown or pale brown on sides (Fig. 163); plates and legs brown. Setae short, brown, pointed.

Measurements: H.W., 1.77-1.94 mm.; W/L, 1.28-1.63; B.L., 16-18 mm.; B.W., 1.0-1.5 mm.; annulets, 5; ventral proleg with 16 crochets in two groups and 5 secondary setae. No. of larvae examined: 10.

L. DESTINATA Moeschler. Fig. 165.

Range: Transcontinental (McDunnough, 1943). The records of the Forest Insect Survey suggest that this species is subalpine in Alberta and the distribution noted by Bowman (1951) confirms this suggestion.

Host: *Salix*.

Life History: Larvae, free-living, from June 7–August 10; pupal period about 11 days; adults in July and August.

Description: *Ultimate*: Head, cuticle reticulate, pale grey, face framed by a broad inverted U-shaped brown band; this band made up of markings arranged in herring-bone pattern; clypeus with brown spot in each corner. Thorax and abdomen reticulate, light brown; M.D., fine, dark grey; body marked with grey or brown lines (Fig. 165); mesothorax swollen laterally. Setae short, brown, pointed.

Measurements: H.W., 1.62–1.66 mm.; W/L, 1.62–1.66; B.L., 20–28 mm.; B.W., 1.5–2.0 mm.; annulets, 7; ventral proleg with 22–25 crochets in two groups, and 5 secondary setae. No. of larvae examined: 6.

Remarks: This species has been collected a number of times on the University of Manitoba campus, where it was found feeding with *L. testata* and other lepidopterous larvae on the sandbar willow, *Salix interior* Rowlee.

L. FLAVIBRUNNEATA McDunnough. Fig. 164.

Range: Nova Scotia (Ferguson, 1955a) to the Rocky Mountains of Alberta (McDunnough, 1943). In Alberta, this species is found on the plains (Bowman, 1951).

Host: *Salix*.

Life History: Larvae, free-living, in July; pupation period, about 13 days; adults in July and August.

Description: *Penultimate*: H. W., 1.03–1.08 mm.. *Ultimate*: Head, cuticle reticulate, pale brown on sides and white on front; dark brown dots on sides and upper part. Thorax and abdomen, reticulate, pale brown; brown pattern of lines and obliques on abdominal segments 1–5 (Fig. 164); prothoracic and anal plates concolorous with body; thoracic legs brown; prolegs brown with pale brown line lengthwise on them. Setae short to moderate in length, brown, pointed.

Measurements: H.W., about 1.70 mm.; W/L, 1.57; B.L., 21–26 mm.; B.W., 1.2–2.0 mm.; annulets, 8; ventral proleg with 25 crochets in two groups, and 5 secondary setae. No. of larvae examined: 4.

L. XYLINA Hulst. Fig. 166.

Range: Maine and Ontario, to Washington and British Columbia, very rare in the east. (Forbes, 1948).

Hosts: *Alnus*, *Salix*, *Potentilla fruticosa* L., *Rosa*, *Symphoricarpos*, *Ribes*, *Ame-lanchier*; more than three-quarters of the adults in the Calgary Laboratory were reared from the first three hosts.

Life History: Larvae, free-living, from middle of June until end of July; about two weeks in pupal stage; adults in July and August.

Description: *Ultimate*: Head, cuticle, reticulate, pale grey-green with brown markings in herring-bone pattern along epicranial stem and over parietal lobes; clypeus olive-green. Thorax and abdomen reticulate, pale grey; M.D., black anteriorly and white posteriorly on each abdominal segment; mottled grey marking on sides and venter; M.V. merged with A.V. colour pattern (Fig. 166). Setae of moderate length, brown, pointed.

Measurements: H.W., 1.75-1.84 mm.; W/L, 1.42-1.68; B.L., 25-32 mm.; B.W., 1.2-2.0 mm.; annulets, 5; ventral proleg with 24 crochets in two groups, and 6 secondary setae. No. of larvae examined: 3.

CERATODALIA Packard

C. GUENEATA Packard. Figs. 41 and 188.

Reference: Dyar (1903d), as *Hydriomena excurvata* Grote.

Range: Southwest corner of Alberta (Bowman, 1951) and southern British Columbia (Jones, 1951).

Host: Dyar (1903d): *Polygonum*.

Life History: Eggs laid early July; larvae hibernate; five larval stages (Dyar, 1903d); adults from May to September (Jones, 1951).

Description: *I.* Head, grey; thorax and abdomen grey, dark granular on a white ground; no markings; no shields. *II.* Head thickly mottled with dark brown; thorax and abdomen grey, obliquely striped in dark brown; a geminate ventral band. H.W., 0.4 mm. *III.* Head thickly mottled in dark brown, with a pale streak on the apex of each lobe. Thorax and abdomen pale, obliquely striped with dark brown; narrow dorsal and subdorsal lines; shaded adventral line. H.W., 0.6 mm.; *IV.* Head grey-black with a bright white streak before the apex of each lobe and another above the ocelli. Thorax and abdomen shaded in dark brown and pale yellow; a narrow dorsal brown line in a brownish-yellow ground, enclosed by a series of diamond-shaped brown marks; a series of broad lateral bands run obliquely posteriorly and shade into a broad, adventral, dark brown band. H.W., 0.95 mm. *V.* Head, cuticle reticulate, pale brown with brown markings arranged in herring-bone pattern on parietal lobes; clypeus brown. Thorax and abdomen reticulate; pale brown with brown markings on dorsum and sides (Fig. 188); on abdominal segments 1-5 inclusive oblique lines run across the intersegmental lines; M.D., brown; S.V., and A.V., brown; M.V., pale ground colour; plates brown; thoracic legs brown; prolegs pale brown. Setae short, brown, pointed.

Measurements: H.W., 1.21-1.30 mm.; W/L, 1.32-1.41; B.L., about 22 mm.; B.W., about 1.5 mm.; annulets 5, ventral proleg with about 18 crochets in two groups and 6 secondary setae. No. of larvae examined: 3.

TRICHODEZIA Warren

T. ALBOVITTATA Guenée. Figs. 42, 65, 94, 112, and 170.

Range: Transcontinental; Gaspe, Quebec to North Carolina, and west to the Pacific (Forbes, 1948).

Hosts: *Epilobium angustifolium* L., *Thalictrum*; Forbes (1948): *Impatiens*.

Life History: Eggs laid in July; eclosion after 7 days; free-living larvae (four instars) in late July and August; hibernate as pupae; adults in June and July.

Description: *I.* Head, pale translucent grey with no markings; thorax and abdomen, pale, translucent grey with green food showing through body wall. H.W., 0.25-0.32 mm.; B.L., 3.8 mm.; B.W., 0.3 mm. *II.* Head pale grey; thorax and abdomen pale grey, with no markings. H.W., 0.42-0.50 mm.; B.L., 7.0 mm.; B.W., 0.5 mm. *III.* Head pale green with pale brown markings; thorax and abdomen pale green. H.W., 0.70-1.00 mm.; B.L., 13 mm.; B.W., 1.0 mm. *IV.* Head, cuticle reticulate; pale green with black or brown bar across head at apex of clypeus. Thorax and abdomen almost smooth; green; only marking is black line along thorax at base of legs, to

meet band across head; anal plate russet colour. Setae of moderate length, brown, pointed.

Measurements: H.W., 1.14-1.33 mm.; W/L, 1.46-1.81; B.L., 8-20 mm.; B.W., 1.0-2.0 mm.; annulets, 5-6; ventral proleg with 10-13 crochets in two groups, and 5 or 6 secondary setae. No. of larvae examined: 6.

Remarks: Description based on larvae the writer reared from eggs laid on fireweed at Seebe, Alberta.

PLEMYRIA Hübner

P. GEORGII Hulst. Figs. 44, 168, and 208.

Range: Transcontinental; Nova Scotia and Maine, west to British Columbia and Washington (Forbes, 1948).

Hosts: *Alnus*, *Salix*, *Betula*.

Life History: Larvae, which may be free-living, or may live in a slight webbing among the leaves, from the middle of June until early September; about 20 days in pupal stage; adults in August and September.

Description: *Penultimate*: Head, yellow-green; thorax and abdomen green with a broad green dorsal stripe; paraprocts long. H.W., 0.80 mm.; B.L., 7.0 mm.; B.W., 0.75 mm. *Ultimate*: Head, cuticle reticulate; pale green or russet-green, sometimes with fine brown markings. Thorax and abdomen rough, covered densely with minute convex spicules; yellow-green; may have rose-coloured subspiracular line; intersegmental regions yellow; paraprocts long, pale or rose-coloured. Setae short, blunt-tipped, pale brown. Measurements: H.W., 1.33-1.52 mm.; W/L, 1.52-1.54; B.L., 18-23 mm.; B.W., 1.0-2.0 mm.; annulets, 5-6; ventral proleg with 8-11 crochets, in two groups, and 5 secondary setae. No. of larvae examined: 6.

DYSSTROMA Hübner

No satisfactory key has been arranged for this genus.

D. WALKERATA Pearsall. Fig. 113.

Range: Transcontinental.

Hosts: *Larix*, *Alnus*.

Life History: Free-living larvae hibernate in second of four instars; about 19 days spent in pupal stage; adults in June and July.

Description: *I*. H.W., 0.38 mm.; *II*. Head brown, with dark brown markings. Thorax and abdomen yellow with orange middorsal and spiracular stripes; two orange lines in subventral region; prothoracic plate concolorous with body; anal plate orange; thoracic legs light brown; prolegs yellow. H.W., 0.56 mm.; B.L., 7.0 mm.; B.W., 0.5 mm. *III*. Head pale russet-green with brown markings in herring-bone pattern on parietal lobes; a band of brown stippling on clypeus; thorax and abdomen green; middorsal line fine, blue-green; in S.D. area, a yellow-white line. H.W., 0.86 mm.; B.L., 15 mm.; B.W., 1.0 mm. *IV*. Head, cuticle, reticulate, green, with pattern of herring-bone markings on parietal lobes. Thorax and abdomen slightly reticulate; green; S.D., white line; L., subspiracular line white or cream-coloured; S.V., pale line; prothoracic plate green; anal plate rose-coloured in part; paraprocts rose-coloured; thoracic legs rose or russet; prolegs, in part, rose-coloured. Setae short, pale, blunt-tipped.

Measurements: H.W., 1.25-1.52 mm.; W/L, 1.25-1.39; B.L., 13-25 mm.; B.W., 1.9-3.0 mm.; annulets, 5-6; ventral proleg with 9-15 crochets, in two groups, and 5-6 secondary setae. No. of larvae examined: 10.

Remarks: Descriptions of stages I, II, and III, made from one larva, Forest Insect Survey, Record No. 1946 Winnipeg 912A, collected at Slave Lake,

Alberta, on September 7, 1946, on tamarack; the larva pupated on June 25, 1947, and emerged as a male on July 10.

D. CITRATA Walker

Reference: Stokoe and Stovin (1948).

Range: Holarctic.

Hosts: *Mertensia*, *Symphoricarpos*, *Alnus*, *Rosa*, *Salix* and *Ribes*; McDunnough (1946): *Vaccinium* and *Fragaria*; Jones (1951): *Rubus*.

Life History: Hibernates as egg (Barnes and McDunnough, 1917); free-living larvae feed in June and early July; about 22 days spent in pupal stage; adults in July and August.

Description: *Ultimate*: Head, cuticle reticulate, pale green, with no markings. Thorax and abdomen almost smooth, green; M.D., grey-green or blue-green line; M.V., fine, pale, or white line; plates pale green; paraprocts long, green or tipped with rose colour; legs pale green. Setae short, pale, blunt-tipped or pointed.

Measurements: H.W., 1.34-1.52 mm.; W/L, about 1.41; B.L., 17-28 mm.; B.W., 1.0-2.0 mm.; annulets, 5; ventral proleg with 12 crochets in two groups, and 5 secondary setae. No. of larvae examined: 3.

D. HERSILIATA Guenée

Reference: Dyar (1904b).

Range: "Northern, ranging south in the mountains to Pennsylvania, the typical form seen west to Manitoba, in varieties to the Pacific". (Forbes, 1948).

Host: *Ribes*.

Life History: Larvae in June; adults in July and August.

Description: *Ultimate*: Head rounded, roughly shagreened, pale green. Thorax and abdomen green, rough with minute secondary spines and small, white tubercles; dorsal blood vessel dark green; white subdorsal line and trace of a lateral one; broken white midventral line. All legs green. Setae small, white (Dyar, 1904b).

Measurements: H.W., 1.50 mm.

D. ETHELA Hulst var. Figs. 12, 51, 75, 91, 92, and 213.

Range: Western North America.

Host: *Ribes*.

Life History: Free-living larvae in June; about 15 days in pupal stage; adults in July and August.

Description: *Ultimate*: Head, cuticle, reticulate (Fig. 91); pale green or russet-green. Thorax and abdomen rough, covered with spicules (Fig. 92); green; S.D., white line; plates concolorous; legs pale green. Setae short, pale, pointed or blunt-tipped.

Measurements: H.W., 1.25-1.42 mm.; W/L, 1.49-1.65; B.L., 15-20 mm.; B.W., 1.9-2.3 mm.; annulets 5-6; ventral proleg with 6-12 crochets in two groups, and 5-6 secondary setae. No. of larvae examined: 10.

Remarks: The rough, green cuticle of this larva gives it the appearance of a leaf petiole of the host plant.

D. FORMOSA Hulst form BOREATA Taylor.

Range: Southern Alberta and British Columbia.

Host: *Ribes*.

Life History: Free-living larvae in June; about 17 days in pupal stage; adults in July and August.

Description: *Ultimate*: Head, reticulate, yellow-green. Thorax and abdomen rough, covered with fine spicules; green; S.D., white line; plates concolorous; thoracic legs pale green; prolegs green. Setae fine, pale, short, with blunt tips.

Measurements: H.W., about 1.50 mm.; B.L., 15 mm.; B.W., 2.0 mm. No. of larvae examined: 1.

Remarks: Description prepared from one larva, Forest Insect Survey; Record No. 1947 Winnipeg 151A, collected in Cypress Hills, Alberta, about June 16, 1947; pupated June 20 and emerged July 7, as a female.

THERA Stephens

Key to Species (Mature Larvae)

- | | |
|--|----------------------|
| 1. Species found in eastern or north-central North America | 2 |
| Species found in western North America | <i>T. otisi</i> |
| 2. Larvae feed in July and early August | <i>T. contracta</i> |
| Larvae feed in June and July, and in September | <i>T. juniperata</i> |

T. OTISI Dyar. Figs. 10, 19, 50, 66, 76, 93, 100, 114, 167, and 211.

Range: Alberta and southeastern British Columbia.

Host: *Juniperus communis* L.

Life History: Probably hibernates in the egg stage; free-living larvae from late May until end of August; about 18 days spent in pupal stage; adults in August and September.

Description: *Antepenultimate*: Head russet colour. Thorax and abdomen pruinose white; M.D., faint green line; S.D., green line near D. setae and broad green stripe in supraspiracular region; L., spiracular stripe green, merged with supraspiracular stripe; S.V., green line; venter green. H.W., 0.48-0.51 mm.; B.L., 7.0 mm. *Penultimate*: Head russet in colour; thorax and abdomen pale green; S.D., green with white lines on each side; L., subspiracular line white; venter green; plates green with yellow edges; legs pale brownish-green. H.W., about 0.95 mm.; B.L., 8-12 mm.; B.W., about 1.0 mm. *Ultimate*: Head cuticle, reticulate (Fig. 100), russet; thorax and abdomen, rough (Fig. 93); pale green; S.D., white or yellow line; in subspiracular, a red line above a white line (some larvae may not have the red line but the writer believes most, and possibly all, larvae develop finally a pattern with the red line); M.V., yellow-green line; plates and legs much as in last instar. Setae short, blunt-tipped, light brown in colour.

Measurements: H.W., 1.50-1.70 mm.; W/L, 1.17-1.50; B.L., 11-18 mm.; B.W., 1.2-2.3 mm.; annulets, 4-6; ventral proleg with 9-10 crochets in two groups, and 5 secondary setae. No. of larvae examined: 12.

T. CONTRACTA Packard

Reference: Packard (1890).

Range: Nova Scotia and Maine, west to Manitoba and Minnesota.

Host: *Juniperus communis* L. Packard (1890) lists other conifers besides common juniper but this is the usual, possibly only, food-plant in Canada.

Life History: Larvae from early July until August 15; adults from late July until September.

Description: The writer knows of no constant difference in colour pattern or measurements between this and the preceding species, *T. otisi*; therefore the description and measurements of the former will suffice for this species also.

Measurements: As for *T. otisi*. No. of larvae examined: 6.

T. JUNIPERATA Linnaeus

Reference: Stokoe and Stovin (1948).

Range: Maine, Nova Scotia, and Ontario (Ferguson, 1955a).

Host: *Juniperus communis* L.

Life History: Larvae feed in June and July in Nova Scotia (Ferguson, 1955a) and in September in Ontario (Raizenne, 1952); adults from late August until October.

Description: These larvae resemble those of *T. otisi* and *T. contracta*.

Measurements: H.W., 1.58-1.67 mm.; W/L, 1.20-1.43; B.L., 15-17 mm.; B.W., about 1.9 mm.; annulets, 4-6; ventral proleg with 6-10 crochets in two groups, and 5 secondary setae. No. of larvae examined: 6.

Tribe Eupitheciini

HORISME Hübner

H. INTESTINATA Guenée. Figs. 5, 45, 48, 97, 98, 119, 171, and 210.

Range: Trancontinental; Quebec to Florida, west to British Columbia (Forbes, 1948).

Host: *Atragene columbiana* Nutt.

Life History: Eggs laid in July; hatch in from 8 to 10 days; free-living larvae from middle of July until middle of August (four instars); hibernates as pupae; adults in late June and early July; Bowman notes (1951) that adults may also be found in October in Alberta; Forbes (1948) indicates there are two generations in New York with adults mainly in June and August.

Description: I. Head light brown. Thorax and abdomen pale green; M.D., fine, brown, line; L, brown line; brown spot below spiracle; M.V., fine brown line. H.W., 0.34-0.40 mm.; B.L., about 5.0 mm. II. Head pale grey with pale brown spots arranged in herring-bone pattern along epicranial stem and on the sides of the head. Thorax and abdomen pale grey; M.D., a fine brown line; S.D., pale brown lines; L, brown patch below seta L-1 and anterior to seta SV-3 on anterior abdominal segments; S.V., geminate brown lines enclosing patches; M.V., brown line; thoracic plate concolorous; anal plate pale grey with brown patch at end of M.D. and S.D. lines; thoracic legs brown; prolegs brown; anal leg has white stripe along it. H.W., 0.65-0.71 mm.; B.L., about 12 mm.; B.W., about 0.8 mm. III. Pattern of head, thorax and abdomen much as in second instar. H.W., 1.07-1.17 mm. IV. Head, cuticle rough (Fig. 97); pale brown with brown herring-bone pattern along epicranial stem and on sides of head. Thorax and abdomen, rough (Fig. 98); pale brown; M.D., dark brown, varying in width; S.D., brown; L, brown lines and stripes; S.V., brown stripe; M.V., ground colour; plates concolorous; legs brown. Setae moderately long, black, pointed.

Measurements: H.W., 1.70-1.90 mm.; W/L, 1.48-1.57; B.L., 22-23 mm.; B.W., about 2.0 mm.; annulets 6; ventral proleg with 14-18 crochets in two groups, and 4 secondary setae. No. of larvae examined: 8.

Remarks: Descriptions based on larvae reared from a gravid female.

EUPITHECIA Curtis

Key to Species (Mature Larvae)

1. Larvae borers in cones 2
Larvae free living, on foliage or in flowers 4
2. Slender larvae, pale pink, unlined, with brown setal bases on thorax and abdomen 3
Stout, grub-like larvae with pale lines on pale pink or brown body *E. albicapitata*
3. Larvae with head width 1.17-1.25 mm.; occur at least as far west as Alberta and possibly to the Pacific *E. mutata*

| | |
|--|--|
| Larvae with head width 1.50-2.01 mm.; occur only on west coast of North America | |
| | <i>E. spermaphaga</i> |
| 4. Larvae green | 5 |
| Larvae grey, orange, or brown | 16 |
| 5. Larvae with red subspiracular line | 6 |
| Larvae with no red subspiracular line | 7 |
| 6. Spiracular line yellow or white | <i>E. ravocostaliata</i> |
| Spiracular line green (Fig. 195) | <i>E. anticaria</i> |
| 7. Middorsal line rose-coloured or grey; if middorsal line grey, dorsum suffused with rose colour | 8 |
| No rose colour on dorsum | 11 |
| 8. Feeding on conifer foliage | 9 |
| Feeding on angiosperm foliage | 10 |
| 9. Head without red reticulate markings but with faint brown markings in herring-bone pattern; feed on <i>Pinus</i> | <i>E. ornata</i> |
| Head often with red reticulate markings but without brown herring-bone pattern; feed on <i>Pseudotsuga</i> and <i>Picea</i> | <i>E. pseudotsugata</i> |
| 10. Head marked with fine red reticulations; feed on <i>Betula</i> | <i>E. gelidata</i> |
| Head unmarked; feed on <i>Alnus</i> | <i>E. sheppardata</i> |
| 11. Spiracular line yellow, broken into yellow patches anterior to spiracles (Fig. 174) | <i>E. gibsonata</i> |
| Spiracular line continuous | 12 |
| 12. White lines on dorsum; larvae feed on <i>Juniperus</i> and <i>Thuja</i> | 13 |
| No white lines on dorsum; larvae feed on <i>Alnus</i> , <i>Salix</i> and <i>Spiraea</i> | 15 |
| 13. Anal plate green with yellow edges; larvae feed in late summer and fall | <i>E. arceuthata</i> |
| Anal plate russet or rust-colour, with pale-coloured edges; larvae feed in early summer | 14 |
| 14. Green phase larvae with white subdorsal line; occur as far west as eastern Saskatchewan | <i>E. sobrinata interruptofasciata</i> |
| Green phase larvae with no white subdorsal line; occur in Alberta and British Columbia | <i>E. niphadophilata</i> |
| 15. Feed on <i>Spiraea</i> and <i>Alnus</i> ; occur in eastern North America | <i>E. stratonata</i> |
| Feed on <i>Salix</i> ; occur in western North America | <i>E. bryanti</i> |
| 16. Larvae with rows of dark spots on body (Fig. 173); head very dark brown or black | <i>E. cretaceata</i> |
| Larvae with lines or designs on dorsum; head light brown or grey | 17 |
| 17. Larvae with dark obliques or arrow-shaped markings on dorsum | 25 |
| Larvae with lines and bands only on dorsum | 18 |
| 18. Midventral line light | 19 |
| Midventral line dark | 23 |
| 19. Spiracular line red (Fig. 186) | <i>E. misturata</i> |
| Spiracular line yellow or orange | 20 |
| 20. Middorsal line fine, grey (Fig. 177); larvae feed on conifers | 21 |
| Middorsal line brown, or a series of ellipsoid-like markings; larvae feed on angiosperm foliage or flowers | 22 |
| 21. Larvae feed on <i>Pinus</i> (Figs. 1 and 177) | <i>E. palpata</i> |
| Larvae feed on conifers other than <i>Pinus</i> | <i>E. transcanadata</i> |
| 22. Larvae feed on foliage of angiosperm trees and shrubs in May, June and early July | <i>E. columbiata</i> |
| Larvae usually feed on flowers but occasionally on foliage of <i>Ribes</i> , <i>Salix</i> , <i>Rosa</i> , and <i>Potentilla</i> in July and August | <i>E. nimbicolor</i> |
| 23. Dorsum pale red, with red spiracular line (Fig. 186) | <i>E. misturata</i> |
| Dorsum grey, orange, or brown | 24 |
| 24. Midventral line fine, red, and often broken (Fig. 182); larvae feed in spring and early summer | <i>E. filmata</i> |
| Midventral line brown (Figs. 2 and 180); larvae in late summer and early fall | <i>E. luteata</i> |
| 25. Midventral line light | 26 |
| Midventral line dark | 29 |
| 26. Head width greater than 1.45 mm.; found in British Columbia and Pacific Coast states; feeds on <i>Thuja</i> , <i>Libocedrus</i> , and <i>Juniperus scopulorum</i> (Fig. 178) | <i>E. placidata</i> |
| Head width less than 1.35 mm.; found across the continent; feeds on many different plants | 27 |
| 27. Head width greater than 1.10 mm. | 28 |
| Head width less than 1.10 mm. | <i>E. satyrata</i> |

28. Larvae feed on *Salix*, *Betula* and *Alnus* (Fig. 189)..... *E. perfusca*
 Larvae generally feed on flowers but occasionally on foliage of *Salix*, *Ribes*, *Rosa*, and
Potentilla..... *E. nimbicolor*
29. Larvae feed in early summer, occasionally as late as July, on foliage of coniferous
 trees (Figs. 183-185 and 187)..... *E. filmata*
 Larvae feed in late summer, August and September, occasionally as early as July,
 on conifer foliage and angiosperm foliage and flowers..... 30
30. Larvae feed on flowers..... *E. coagulata*
 Larvae feed on foliage..... 31
31. Pale oblique marking above spiracles of anterior abdominal segments (Figs. 189,
 and 190); larvae feed on conifers and angiosperms..... 32
 No pale oblique marking above spiracles (Fig. 188); larvae feed on *Picea glauca*;
 occurs in Alberta and British Columbia..... *E. kasloata*
32. Subspiracular stripe broad (Fig. 190); head about 0.9 mm. in width..... *E. castigata*
E. fletcherata
 Subspiracular stripe narrow (Fig. 189); head more than 1.1 mm. in width..... *E. perfusca*

E. MISTURATA MISTURATA Hulst

References: Dyar (1904b); Ross and Evans (1956a).

Range: Pacific coast states from southern California north to British Columbia
 and southern Alberta, and east to the Rocky Mountains in Colorado, Utah,
 and New Mexico (McDunnough, 1949).

Hosts: *Salix*; Ross and Evans (1956a): *Rhamnus purshiana* de Cand., *Malus
 pumila* Mill.; Rindge (1952): *Baccharis pilularis* de Cand.; Dyar (1904b):
 flowers of *Ceanothus*.

Life History: In California, larvae (free living, four instars) in October and
 adults in December (Rindge, 1952); in British Columbia, larvae in mid-
 summer and adults throughout summer.

Description: *I.* Head pale, testaceous, smoky shaded; body translucent, tes-
 taceous, faintly smoky shaded; legs and setae pale. *II.* Dyar (1904b) did
 not describe the second stage. *III.* Head white; body waxy white, with
 narrow smoky black dorsal line; legs all brown tipped. H.W., 0.6 mm.
IV. Head white, the lobes thickly brown-dotted, arranged obscurely in two
 vertical bands. Body white or pale green, not shining, a broad dorsal
 smoky band widened between dorsal setae; a subdorsal series of cuneiform
 brown marks; thoracic legs brown-ringed.

Ross and Evans (1956a) did not note the cuneiform marks but they did
 mention a yellow spiracular line.

Measurements: H.W., 1.00 mm.

E. MISTURATA FROSTIATA Swett. Fig. 186.

Range: Nova Scotia, west to foothills of Alberta in Canada; Northeastern
 United States from the Black Mountains of North Carolina north and west
 to Pennsylvania (McDunnough, 1949).

Host: *Larix*.

Life History: Larvae, free-living, in June and July; hibernate as pupae; adults
 in spring and in August, in two broods (Ferguson, 1955a).

Description: *Penultimate*: Head yellow, with fine brown dots arranged in
 herring-bone pattern; body yellow, broad red middorsal stripe, fine red
 supraspiracular or spiracular line and fine pink subspiracular line; venter
 pale yellow. H.W., 0.65 - 0.72 mm.; B.L., about 8 mm.; B.W., 1.0 mm.
Ultimate: Head, cuticle, rough; yellow, russet, or pale brown, with or
 without a herring-bone pattern of fine, brown dots. Thorax and ab-
 domen, rough, somewhat as in *E. cretacea* (Fig. 96); yellow or pale green;
 M.D., dull red line; red line bears setae D; S.D., red line; L, spiracular line,
 broken, red; subspiracular stripe, red; venter pale yellow, with or without

fine red M.V. line. Arrangement of colour in subdorsal, and spiracular lines may give impression of oblique markings on sides of body. Setae about 0.2 mm. in length, pale brown, pointed.

Measurements: H.W., 0.84 - 1.20 mm.; W/L, 1.12; B.L., 10 - 15 mm.; B.W., 1.0 - 1.2 mm.; ventral proleg with about 8 crochets in two groups. No. of larvae examined: 5.

E. BRYANTI Taylor

Range: From California and Utah, north to Alaska and Alberta (McDunnough, 1949; Rindge, 1952).

Host: *Salix*.

Life History: Larvae, free-living, in May and June; 16 - 24 days in pupal stage; adults in June and July in Alberta and British Columbia, in April and May in California, and in August in Utah and Alaska. (McDunnough, 1949; Bowman, 1951; Rindge, 1953; Ross and Evans, 1956a).

Description: *Ultimate*: Head, cuticle rough, pale brown; thorax and abdomen rough, much as in *E. cretacea* (Fig. 96); green. Setae about 0.2 mm. in length.

Measurements: H.W., 0.88 - 0.90 mm.; W/L, 1.59 - 1.65; B.L., about 10 mm.; B.W., about 1.7 mm.; annulets, 4; ventral proleg with 8 - 10 crochets in two groups, and 4 secondary setae. No. of larvae examined: 2.

E. CASTIGATA Hübner. Fig. 190, and Dietze (1910-1913): Pl. 25.

References: Deitze (1910 - 1913); Stokoe and Stovin (1948); Juul (1948); Hoffmeyer (1952); Rindge (1952).

Range: Holarctic; transcontinental in North America.

Hosts: *Epilobium*, *Salix*; Jones (1951): *Picea*; Ferguson (1955a): *Alnus*; Ross and Evans (1956a): *Alnus rubra* Bong., *Populus balsamifera* L.

Life History: Larvae, free-living, in August and early September; hibernate as pupae; adults in June and July.

Description: *Ultimate*: Head, cuticle rough; pale to dark brown; with markings of brown; these markings may be arranged in herring-bone pattern; thorax and abdomen rough, spicules more elongate than in *E. luteata* (Fig. 95), brown; M.D., a series of dark brown diamond-shaped patches, one to each segment, on first five abdominal segments; these patches are connected by dark brown line; posterior segments with brown suffusion on dorsum; sides patterned with dark brown subspiracular line and pale oblique posterior to each spiracle; M.V., fine, brown line. (Fig. 190) and Dietze (1910-1913); anal plate pale brown, with M.D. line crossing it. Setae about 0.2 mm. in length.

Measurements: H.W., 0.93 mm.; W/L, 1.13; B.L., about 18 mm.; B.W., 0.7 mm.; annulets, 7; ventral proleg with about 9 crochets, in two groups, and 4 secondary setae. No. of larvae examined: 2.

E. ALBIPUNCTATA Haworth. Fig. 181, and Dietze (1910 - 1913): Pl. 56.

References: Dietze (1910 - 1913); Hoffmeyer (1952).

Range: Holarctic; transcontinental in North America (McDunnough, 1949).

Hosts: McDunnough (1949): flowers and seeds of *Viburnum*; Hoffmeyer (1952): flowers and fruits of *Angelica*; Dietze (1910 - 1913): umbels of *Heracleum*, *Angelica*, and *Sambucus*; Rindge (1952): *Heracleum lanatum* Michx.

Life History: Larvae feed in August in Nova Scotia; probably hibernate as pupae; adults in April, May, and June in southern part of range and, in July, in northern part.

Description: *Ultimate*: Head, cuticle, rough, dark brown, with pale brown patches. Thorax and abdomen rough, covered with large and small rounded, wart-like spicules; brown, thoracic segments with dark stripes on dorsum; anterior abdominal segments with dark triangles on dorsum; anterior to triangles are light obliques; venter pale brown; M.V., fine dark line (Fig. 181); legs concolorous with body. Setae about 0.2 mm. in length.

Measurements: H.W., 1.00 mm.; W/L, 1.00; B.L., about 15 mm.; B.W., 1.5 mm.; annulets, 7; ventral proleg with 8 - 16 crochets in two groups. No. of larvae examined: 1.

E. FLETCHERATA Taylor

References: McGuffin (1945); Rindge (1952).

Range: Transcontinental in Canada and in these northeastern states of the United States: New York, Maine, New Hampshire, Pennsylvania, and Michigan.

Hosts: *Larix*, *Picea*, *Salix*; MacKay (1951): *Alnus*.

Life History: Larvae, free-living, in late July and August in Alberta; hibernate as pupae; adults in June. In eastern North America there is a moth flight in August (Forbes, 1948; Ferguson, 1955a).

Description: *Ultimate*: Head, cuticle, rough; greyed yellow to brown, with a light line over each parietal lobe and dark brown markings arranged in herring-bone pattern along epicranial stem; thorax and abdomen, rough, spicules a little longer than in *E. luteata* (Fig. 95); yellow-brown to orange or brown; M.D., grey or dark brown, geminate on thorax, forming diamond-shaped patches on first six abdominal segments; light and dark obliques in lateral region; dark obliques fused with subspiracular dark brown stripe; M.V., fine brown line; venter pale. Setae about 0.25 mm. in length.

Measurements: H.W., 0.92 - 1.10 mm.; B.L., about 13 mm.; B.W., 1.0 - 1.5 mm.; ventral proleg with 10 - 12 setae in two groups. No. of larvae examined: 3.

E. KASLOATA Taylor. Figs. 3 and 188.

Range: Alberta and British Columbia.

Host: *Picea glauca* (Moench) Voss.

Life History: Larvae in August; hibernate as pupae; adults in June in Alberta (Bowman, 1951) and in July and August in British Columbia (Jones, 1951).

Description: *Ultimate*: Head, cuticle, rough; pale grey or brown with brown specks arranged in a herring-bone pattern over the parietal lobes. Thorax and abdomen, rough somewhat like *E. cretacea* (Fig. 96); pale grey; M.D., dark grey, broadening on anterior segments into patches on abdominal segments 1 - 5 inclusive; S.D., broken dark brown line, widest and darkest over spiracles; large grey patches around spiracles; subventral area grey-brown; M.V., fine brown line. Setae moderate in length, about 0.2 mm.

Measurements: H.W., 0.92 - 1.00 mm.; W/L, 1.23 - 1.37; B.L., 10 - 13 mm.; B.W., 1.0 - 1.2 mm.; annulets, 6 - 8; ventral proleg with 14 - 20 crochets in two groups, and 4 secondary setae. No. of larvae examined: 2.

E. LUTEATA Packard. Figs. 2, 68, 74, 77, 95, 118, 180, and 212.

References: Packard (1890); McGuffin (1945a); Ross and Evans (1956a).

Range: Transcontinental.

Hosts: *Picea*, *Tsuga*, *Larix*, *Abies*; Ross and Evans (1956a): (for *E. luteata bifasciata* Dyar): *Picea*, *Abies*, *Larix*, *Tsuga*, *Pinus*, and *Pseudotsuga menziesii* (Mirb.) Franco.

Life History: Larvae, free-living, from early July until late September; hibernate as pupae; adults in late May and June.

Description: *Penultimate:* Head greyed yellow, with light brown markings arranged in a herring-bone pattern along the epicranial stem and over the parietal lobes. Thorax and abdomen brownish-yellow; middorsal line dark, grey-brown stripe, geminate on thorax; subdorsal line brown; spiracular line dark brown; subventral, pale grey or white, and midventral line brown. H.W., 0.50 - 0.70 mm.; B.L., 10 - 12 mm.; B.W., 0.8 - 1.0 mm. *Ultimate:* Head, cuticle, rough; light yellow to greyed yellow, with clypeus brown; thorax and abdomen, rough (Fig. 95); greyed yellow to yellow-brown; M.D., grey to greyish-purple, somewhat thicker on anterior portion of abdominal segments than on posterior; S.D., yellow, through orange, to greyish-orange; L., spiracular line yellow; subspiracular line brown; S.V., white to light grey; M.V., brown to reddish-brown. Some larvae have bands of greyish-purple on the anterior third of the first five or six abdominal segments. Setae short to moderate in length, 0.17 - 0.20 mm.

Measurements: H.W., 0.92 - 1.05 mm.; W/L, 1.19 - 1.45; B.L., 10 - 13 mm.; B.W., 1.0 - 1.3 mm.; annulets, 7; ventral proleg with 10 - 26 crochets in two groups, and 4 secondary setae. No. of larvae examined: 12.

E. PALPATA Packard. Figs. 1 and 177; McGuffin (1942).

References: McGuffin (1942, 1945a); MacKay (1951).

Range: Transcontinental.

Host: *Pinus*.

Life History: Larvae, free-living, in August and September; hibernate as pupae; adults in May and June.

Description: *Ultimate:* Head, cuticle, rough; yellow-orange to red-orange. Thorax and abdomen rough, similar to *E. luteata* (Fig. 95); yellow, orange, or red; M.D., dark grey; spiracular stripe yellow, sometimes with orange suffusion on posterior segments; subspiracular stripe orange or grey; S.V., slightly darker than subspiracular; M.V., white or yellowish-white (Figs. 1 and 177); prothoracic shield concolorous with dorsum, bearing a geminate middorsal line; anal shield orange, with yellow at sides and at anterior corners; thoracic legs light orange; prolegs light orange or pink. Setae short, 0.13 - 0.17 mm. in length.

Measurements: H.W., 1.00 - 1.20 mm.; W/L, about 1.23; B.L., 10 - 18 mm.; B.W., 1.0-1.5 mm.; annulets, 6-7; ventral proleg with 8-14 crochets, in two groups and 4 secondary setae.

E. TRANSCANADATA MacKay

Reference: MacKay (1951).

Range: Transcontinental.

Hosts: MacKay (1951): *Tsuga*, *Picea*, *Abies*, *Thuja*, *Larix*, *Pinus*, and *Pseudotsuga menziesii* (Mirb.) Franco.

Life History: Larvae, free-living, in late summer; hibernate as pupae; adults in June and early July.

Description: *Ultimate:* much like *E. palpata* but darker in colour.

Measurements: H.W., 1.02-1.04 mm.; W/L, about 1.39; B.L., 10-15 mm.; B.W., about 1.1 mm.; annulets, 7; ventral proleg with 8-14 crochets in two groups, and 4 secondary setae. No. of larvae examined: 6.

E. ORNATA Hulst

Reference: MacKay (1951).

Range: Colorado, New Mexico, and Utah (McDunnough, 1949); British Columbia (MacKay, 1951; Ross and Evans, 1956a); Alberta, as far north as Jasper.

Host: *Pinus*.

Life History: Larvae, free-living, in late summer up to the end of September; hibernate as pupae; adults in mid-summer.

Description: *Ultimate*: Head, cuticle, rough; pale brown, with faint brown markings arranged in herring-bone pattern along epicranial stem and over the parietal lobes. Thorax and abdomen rough, somewhat like *E. cretaceata* (Fig. 96); green (of pine needles); M.D., brick-red stripe; L., pale yellow-green; M.V., fine pale yellow-green when present; sometimes venter is pale green; prothoracic and anal plates concolorous with body; paraprocts red at tips; thoracic legs pale brown; prolegs green, with red suffusion on outer aspects of anal legs. Setae short, less than 0.2 mm. in length.

Measurements: H.W., 1.17-1.34 mm.; W/L, 1.17-1.34; B.L., 12-18 mm.; B.W., 1.2-1.5 mm.; annulets, 7; ventral proleg with 10 crochets in two groups, and 4 secondary setae. No. of larvae examined: 10.

E. PSEUDOTSUGATA MacKay

Reference: MacKay (1951).

Range: Interior of British Columbia; western Alberta.

Hosts: *Pseudotsuga menziesii* (Mirb.) Franco; occasionally *Picea*.

Life History: Larvae, free-living, from late July until September (MacKay, 1951); hibernate as pupae.

Description: *Ultimate*: Head, cuticle, rough; pale green or russet with red reticulate markings on parietal lobes; clypeus ground colour. Thorax and abdomen, rough, like *E. ornata*; pale green (of fir needles); M.D., fine grey line; A.D., may be red stripe or ground colour; S.D., pale yellow-green; M.V., pale line. Plates and legs concolorous; paraprocts red-tipped when red A.D. stripe present. As MacKay (1951) points out there may be two colour phases, one with red in the dorsum and one without. Setae short, not over 0.2 mm. in length.

Measurements: H.W., about 1.15 mm.; W/L, about 1.45; B.L., 18-21 mm.; B.W., 1.5-2.0 mm.; ventral proleg with about 11 crochets in two groups, and 4 secondary setae. No. of larvae examined: 3.

E. SHEPPARDATA McDunnough

Range: Ontario, Quebec, and New York (McDunnough, 1949); Alberta: Cold Lake, Athabasca, and the Porcupine Hills.

Host: *Alnus*.

Life History: Larvae, free-living, in August and early September; pupae hibernate; adults in late May and June.

Description: *Ultimate*: Head, cuticle, rough; pale russet-green with no markings. Thorax and abdomen, rough, somewhat like *E. luteata* (Fig. 95); green; M.D., red-brown or grey on anterior abdominal segments and reddish on posterior segments; middorsal line may form an elliptical marking on abdominal segments 1-6 inclusive; subspiracular line yellow; venter pruinose, white; prothoracic shield concolorous with body; anal shield with median stripe of rose or brick-red and yellow or green at edges; legs pale green. Setae moderate length, about 0.2 mm. and dark in colour.

Measurements: H.W., 0.95-1.20 mm.; W/L, 1.17-1.19; B.L., 16-20 mm.; B.W., 1.2-1.8 mm.; annulets, 7; ventral proleg with 8-10 crochets, in two groups, and 4 secondary setae.

E. COLUMBIATA COLUMBIATA Dyar

Reference: Ross and Evans (1956a).

Range: British Columbia and Alberta.

Hosts: *Salix*, *Alnus*, *Populus*, and *Amelanchier*; MacKay (1951): *Betula*, *Acer*.

Life History: Larvae, free-living, in late June and July; hibernate as pupae; adults in April, May, and June.

Description: *Ultimate*: Head, cuticle, rough, light brown with brown markings arranged in herring-bone pattern along the epicranial stem and over the parietal lobes. Thorax and abdomen rough, as in *E. cretacea* (Fig. 96); brownish-red; M.D., grey, flanked by grey arcs on abdomen.

Measurements: B.L., about 10 mm. No. of larvae examined: 1.

Remarks: This description based on a larva (Forest Insect Survey, Record No. 1953 Alberta 988c) collected at Kinuso, Alberta, on alder on July 22; pupated July 30, and emerged as a male, after incubation.

E. COLUMBIATA HOLBERGATA MacKay.

Reference: Ross and Evans (1956a).

Range: Vancouver Island and the coastal area of British Columbia (MacKay, 1951).

Hosts: MacKay (1951): *Alnus*, *Salix*, *Rhamnus*.

Life History: Larvae, free-living, in late June and early July; hibernate as pupae.

Description: *Ultimate*: "Reddish-brown body; vague lines on dorsum; broken dark subdorsal stripe; short anal tubercles" (Ross and Evans, 1956a).

E. COLUMBIATA ERPATA Pearsall. Fig. 179.

Range: Eastern United States and Canada (McDunnough, 1949).

Host: *Prunus virginiana* L.

Life History: Larvae, free-living, in May and June; hibernate as pupae; adults in May and June.

Description: *Ultimate*: Head, cuticle rough; light brown with brown markings arranged in herring-bone pattern along the epicranial stem and over the parietal lobes. Thorax and abdomen rough, as in *E. cretacea* (Fig. 96); pale grey, suffused with pink; M.D., brown line; A.D., light brown stripe on thorax, red on abdomen; S.D., yellow-brown line above, red line below in the subdorsal area; L., subspiracular line red; venter pale yellowish-white; prothoracic shield light brown with middorsal and addorsal lines crossing it; anal plate pale, with pink suffusion; legs pale brown, anal prolegs pink. Other larvae may be patterned as in Fig. 179 or intermediate between these extremes. Setae moderate in length, about 0.2 mm.

Measurements: H.W., 0.92-0.98 mm.; W/L, 1.17-1.30; B.L., 10-22 mm.; B.W., 1.0-1.5 mm.; annulets, 6; ventral proleg with 8-9 crochets in two groups, and 4 secondary setae. No. of larvae examined: 10.

E. PLACIDATA Taylor. Fig. 178.

Reference: Ross and Evans (1956a).

Range: British Columbia to California, Utah, and Arizona (McDunnough, 1949).

Hosts: MacKay (1951): *Thuja plicata* Donn.; Ross and Evans (1956a): *Juniperus scopulorum* Sarg.; McDunnough (1949): *Libocedrus deccurens* Torr.

Life History: Larvae, free-living, feed in late summer; hibernate as pupae; adults from late July to October in Sonoma County, California; in July in British Columbia, and in June in Utah (McDunnough, 1949).

Description: *Ultimate*: Head, cuticle, rough; pale brown, with or without brown markings arranged in herring-bone pattern along epicranial stem and over parietal lobes. Thorax and abdomen rough, much as in *E. cretacea* (Fig. 96); M.D., black or brown, geminate on thorax, but a succession of diamond-like or inverted Y-markings on abdomen; spiracles in pale obliques; venter pale; prothoracic plate concolorous with body; anal plate brown with brown middorsal areas; legs pale brown. Setae short, about 0.15 mm. in length.

Measurements: H.W., 1.50-1.56 mm.; W/L, about 1.29; B.L., 10-15 mm.; B.W., about 2.3 mm.; annulets, 7; ventral proleg with 9-13 crochets in two groups, and 4 secondary setae. No. of larvae examined: 4.

E. SATYRATA Hübner. Figures in Dietze (1919-1913): Pl. 25.

References: Dietze (1910-1913); Stokoe and Stovin (1948); Juul (1948); Rindge (1952); Hoffmeyer (1952).

Range: Holarctic; *E. satyrata fumata* Taylor occurs in Eastern Canada and the New England States (McDunnough, 1949); *E. satyrata intimata* Pearsall is found in the southern Appalachian region (McDunnough, 1949); and *E. satyrata dodata* Taylor is in Alberta and British Columbia (Bowman, 1951; Jones, 1951). Specimens of *E. satyrata* have been collected in Alaska (McDunnough, 1949) and Yukon Territory (Ross and Evans, 1956a).

Hosts: *Epilobium*, *Rubus*, *Potentilla fruticosa* L., *Aster*, *Salix*, and *Alnus* for *E. satyrata dodata*; for *E. satyrata fumata*, McDunnough (1949) records: *Aralia*, *Thalictrum*, *Viburnum*, *Scrophularia*, and Rindge (1952) adds: fruit of *Viburnum cassinoides* L., flowers of *Chelone glabra* L., and blossoms of *Spiraea*.

Life History: Larvae, free-living, feed in August and September; hibernate as pupae; adults in May and June.

Description: *Ultimate*: Head, cuticle rough; yellow, pale brown or creamy, with brown dots, which may be arranged in a herring-bone pattern. Thorax and abdomen rough, somewhat as in *E. luteata* (Fig. 95); yellow, pale cream, or pale brown; M.D., brown line, or series of arrow-like or triangular markings, one to each of first five or six abdominal segments; brown lines or obliques in supraspiracular and subspiracular regions; venter ground colour; plates and legs concolorous. Setae of moderate length about 0.2 mm..

These larvae are very variable in appearance (Dietze, 1910-1913).

Measurements: (*E. satyrata dodata*): H.W., 1.00-1.08 mm.; W/L, 1.25-1.38; B.L., 18-20 mm. B.W., 1.2-1.9 mm.; annulets, 6-7; ventral proleg with 9-10 crochets in two groups, and 4 secondary setae. No. of larvae examined: 6.

E. ARCEUTHATA Freyer. Fig. 175. and Dietze (1910-1913): Pl. 49.

References: Dietze (1910-1913); McDunnough (1942); Ross and Evans (1956a).

Range: Holarctic; transcontinental in North America.

Host: *Juniperus*.

Life History: Larvae, free-living, middle of July until middle of September; hibernate as pupae; adults in June and early July (Ferguson, 1955a).

Description: *Antepenultimate*: H.W., 0.76 mm.; B.L., 6.0 mm. *Penultimate*: Head pale russet in colour. Body green with dark green middorsal line, white subdorsal and subspiracular stripes; dark green supraspiracular and subventral stripes; pale midventral line; H.W., 0.95-1.05 mm.; B.L., 8.0 mm.; B.W., 1.0 mm. *Ultimate*: Head, cuticle, rough; pale grey-green. Thorax and abdomen rough, somewhat as in *E. luteata* (Fig. 95); green;

much as in penultimate instar but dark green stripes of that instar are grey-green in this instar (Fig. 175); prothoracic plate green; anal plate grey-green with yellow or white edges; legs green. Setae short, about 0.17 mm. in length.

Measurements: H.W., 1.20-1.52 mm.; W/L, 1.16-1.40; B.L., 11-16 mm.; B.W., 1.2-2.3 mm.; annulets, 6-7; ventral proleg with 8-12 crochets in two groups and 4 secondary setae. No. of larvae examined: 10.

Remarks: Description prepared from one larva (Forest Insect Survey, Record No. 1953 Alberta 1003A, larva no. 2), collected near Peace River, Alberta, on common juniper, on July 18, 1953; pupated August 18; hibernated as pupa; emerged as female.

E. GIBSONATA Taylor. Figs. 70 and 174; McGuffin (1942).

References: McGuffin (1942); McDunnough (1942).

Range: Eastern Canada; New England and North Atlantic States (McDunnough, 1949); southeastern Manitoba and northern Minnesota; coastal region of British Columbia (MacKay, 1951).

Host: *Thuja*.

Life History: Larvae, free-living, from July to early October; hibernate as pupae; adults in June (Raizenne, 1952).

Description: *I.* Yellow larvae. H.W., 0.32 mm.; B.L., 1.14-1.80 mm. *Inter-mediate*: Unknown; *Ultimate*: Head, cuticle, rough, pea-green. Thorax and abdomen rough, as in *E. luteata* (Fig. 95); green, M.D., bluish-green line; S.D., yellow to green with large grey spot in middle of each of abdominal segments 1-8, inclusive; L, spiracular line white at mid segments and grey at intersegments; M.V., pale yellow or white line (Fig. 174); prothoracic shield green, yellow anteriorly; anal shield green, edged with yellow; thoracic legs green proximally, light brown distally; prolegs green. Setae short, stout, 0.13 mm. in length.

Measurements: H.W., 1.40-1.56 mm.; W/L, 1.33-1.34; B.L., 17-19 mm.; B.W., 1.5-2.0 mm.; annulets, 7; ventral proleg with 10-16 crochets in two groups; and 4 secondary setae. No. of larvae examined: 10.

E. STRATTONATA Packard

Range: Eastern North America (McDunnough, 1949).

Hosts: *Spiraea alba* du Roi; Ferguson (1955a): *Alnus*.

Life History: Larvae, free-living, from late June until early August; hibernate as pupae; adults in June and early July (Ferguson, 1955a).

Description: *Ultimate*: Head, cuticle rough, yellow-green with pea-green clypeus. Thorax and abdomen very rough; prominent white spicules longer than those of *E. luteata* (Fig. 95); yellow-green; M.D., grey, very dark on posterior abdominal segments; L, spiracular line yellow; M.V., fine white line in pruinose green venter; prothoracic plate concolorous with body; anal plate yellow-green with dark grey median line and white sides; legs green, pale brown at tips. Setae moderate, about 0.2 mm. in length.

Measurements: H.W., about 1.20 mm.; W/L, 1.58; B.L., 17-23 mm.; B.W., about 1.4 mm.; annulets, 7; ventral proleg with 10-12 crochets, in two groups, and 4 secondary setae. No. of larvae examined: 3.

E. COAGULATA Guenée

Range: Transcontinental; as far north in Canada as Waskesiu and Meadow Lake, Saskatchewan, and as far south in United States as Arizona and California.

Hosts: Flowers of *Achillea*, *Solidago*, *Aster*, and *Aconitum*.

Life History: Larvae, free-living, from August 13 until September 13; hibernate as pupae; adults in June in British Columbia (Jones, 1951); in July and August in Alberta (Bowman, 1951) and Nova Scotia (Ferguson, 1955a); and from May to August in New York (Forbes, 1948).

Description: *Ultimate:* Head, cuticle, rough; pale brown, or brown, with brown or dark brown specks, these specks may be arranged in herring-bone pattern. Thorax and abdomen, yellow or pale grey; M.D., grey-brown, geminate on thorax, and forming an elliptical or diamond-shaped marking on each of the first five abdominal segments; anteriorly these markings are flanked by chocolate-brown obliques; S.D., rose-coloured or brown, touching the dorsal markings on the anterior abdominal segments; sides with, or without, red lines, in supraspiracular and subspiracular areas; spiracles of anterior abdominal segments in red or red-orange patches or obliques; M.V., grey-brown or white line; prothoracic plate concolorous with body; anal plate ground colour with red or brown median stripe; legs ground colour. Setae short, brown.

Measurements: H.W., about 1.08 mm.; B.L., 12-18 mm.; B.W., about 2.0 mm.
No. of larvae examined: 3.

E. NIMBICOLOR Hulst.

Range: Transcontinental; Nova Scotia (Ferguson, 1955a) to British Columbia, Arizona, and California (McDunnough, 1949).

Hosts: Flowers of *Achillea*, and *Castilleja*; foliage of *Salix*, *Rosa*, *Potentilla fruticosa* L., and *Ribes*. One moth indicated a preference for the flower of *Castilleja* by laying all eggs on it when there was also a choice of foliage of *Castilleja*, *Salix*, and *Ribes*.

Life History: Eggs laid in early summer take 10-14 days to hatch; larvae, free-living in July and August, develop to pupal stage in about 30 days (four instars); hibernate as pupae; adults in May, June, and July (McDunnough, 1949; Bowman, 1951).

Description: *I.* Pale brown head. Thorax and abdomen pale grey on dorsum; very pale grey venter. H.W., 0.30-0.32 mm.; B.L., about 3.5 mm.; B.W., about 0.30 mm. *II.* Head pale brown. Thorax and abdomen pale yellow with purplish-red middorsal line; H.W., 0.45-0.50 mm.; B.L., about 8.0 mm.; B.W., about 0.5 mm. *III.* (The larval progeny of one parent may display two colour patterns (a) and (b) in the third and fourth instars).; (a) Head pale russet. Thorax and abdomen pale yellow-green with fine reddish-brown middorsal line, and on the thorax only, a pale brown lateral line. (b) Head pale brown. Thorax and abdomen pale yellow-green; M.D., broad reddish-brown stripe; L, fine, pale reddish-brown line in supraspiracular and spiracular areas; subspiracular stripe, reddish-brown; S.V., and A.V., greyed yellow-green; M.V., pale yellow green line; H.W., 0.71-0.84 mm.; B.L., about 12 mm.; B.W., about 1.0 mm. *IV.* Head cuticle rough; pale brown to pale yellow-green, with brown markings arranged in herring-bone pattern along epicranial stem and over sides of the head. Thorax and abdomen, rough, (a) pale yellow-green; M.D., fine grey line; L., a pale brown line in supraspiracular area on thorax only; subspiracular line brown. (b) yellow; M.D., grey line; A.D., pale orange; L, supraspiracular line reddish-brown; subspiracular, reddish-brown stripe; S.V., and A.V., pale yellow; M.V., fine white line; anal plate ground colour with broad middorsal brown stripe, subspiracular lines end on this plate.

There may also be other patterns. In field-collected larvae, reared to adults, these variations were noted: M.D., geminate grey, thickened on all but last two abdominal segments, to form elliptical markings; L, supra-spiracular, pale grey line; subspiracular, pale yellow; S.V., and A.V., brown stripe; M.V., white or pale grey. Setae pale brown, short.

Measurements: H.W., 1.14-1.17 mm.; B.L., 15-20 mm.; B.W., about 1.3 mm.

No. of larvae examined: 12.

Remarks: Descriptions based on larvae reared from gravid females.

E. GELIDATA Moeschler. Figure in Dietze (1910-1913) Pl. 66. (*E. hyperboreata* Staudinger).

References: Dietze (1910-1913); Juul (1948).

Range: Holarctic; transcontinental in North America; south to Colorado and New Mexico and north to Alaska (McDunnough, 1949).

Hosts: *Betula*, *Alnus*; Dietze (1910-1913): *Ledum*; MacKay (1951): *Salix*.

Life History: Larvae, free-living, in August and September; hibernate as pupae; adults in June and July.

Description: *Ultimate*: Head, cuticle, rough; pale brown or green with fine red reticulate markings on parietal lobes. Thorax and abdomen, rough, yellow-green; M.D., fine grey line; rose suffusion in dorsum may extend to supraspiracular region; spiracles may be in rose-coloured patches; remainder yellow-green; plates, rose-coloured; thoracic legs brown; prolegs, pale green. Setae short, brown.

Measurements: H.W., 1.14-1.20 mm.; W/L, 1.32-1.39; B.L., 15-22 mm.; B.W., 1.2-1.8 mm.; annulets, 7; ventral proleg with 18 crochets in two groups and 4 secondary setae. No. of larvae examined: 5.

E. KANANASKATA MacKay

Range: Adults have been reared from larvae collected in Alberta on the Kananaskis Forest Experiment Station, and at Coleman, and Waterton Lakes, and in British Columbia at Kaslo, Vedder, and Chilliwack (MacKay, 1951; Ross and Evans, 1956a).

Hosts: *Salix*, *Alnus*, *Populus*.

Life History: Larvae, free-living, feed in late August and September; hibernate as pupae.

Description: *Ultimate*: Head, cuticle, rough; yellow with brown flecks arranged in herring-bone pattern on the parietal lobes. Thorax and abdomen, rough; pale orange; M.D., brown; on abdominal segments 1-5 inclusive, an arrow-like markings; S.D., fine broken, wavy brown line; L, spiracular yellow, with spiracles in pale orange patch; subspiracular area brown, fading into yellow on venter; M.V., fine brown line; plates pale orange; anal plate yellow at edges, with middorsal line running to tip; legs pale brown. Setae short, brown.

Measurements: H.W., about 1.0 mm.; B.L., 18 mm.; B.W., 1.2 mm. No. of larvae examined: 1.

Remarks: Description based on one larva (Forest Insect Survey, Record No. 1948 Alberta, 454, I) collected on the Kananaskis Forest Experiment Station, Seebe, Alberta, on willow; collected August 24, pupated September 13 or 14; emerged as male. This male is the holotype of the species (MacKay, 1951).

E. PERFUSCA ALBERTA Taylor. Fig. 189.

Range: Rocky Mountain region of Alberta (McDunnough, 1949) and in the Parkland region of this province (Bowman, 1951).

Hosts: *Salix*, *Alnus*, *Betula*.

Life History: Larvae, free-living, in August and September; hibernate as pupae; adults in June and July (Bowman, 1951).

Description: *Ultimate*: Head, cuticle rough; light-brown or russet-colour with markings of darker colour. Thorax and abdomen rough, somewhat as in *E. luteata* (Fig. 95); yellow, pale yellow-green or light brown; M.D., brown, or dark brown line, broadened on abdominal segments 1-6 inclusive, to form diamond-shaped markings which may resemble in shape a bird with outstretched wings; spiracular line, wavy, yellow, the spiracles often flanked anteriorly and posteriorly by dark brown obliques; subspiracular red-brown or dark brown region; venter pale; M.V., pale, brown or red-brown, line (Fig. 189); plates concolorous; anal has median line brown, or red-brown; legs rose-coloured, brown, or pale orange. Setae short.

Measurements: H.W., 1.13-1.33 mm.; W/L, 1.55-1.75; B.L., 15-22 mm.; B.W., 1.0-2.3 mm.; annulets, 6-7; ventral proleg with 14 crochets in two groups, and 4 secondary setae. No. of larvae examined: 6.

E. PERFUSCA KOOTENAIATA Dyar.

Reference: Ross and Evans (1956a).

Range: South central region of British Columbia (McDunnough, 1949); Yukon Territory (Ross and Evans, 1956a).

Hosts: *Salix*, *Alnus*, *Betula*.

Life History: Much the same as in *E. perfusca alberta*.

Description: *Ultimate*: "Body yellowish with dark long diamond pattern on dorsum" (Ross and Evans, 1956a).

Measurements: None available.

E. NIPHADOPHILATA Dyar. Figs. 6 and 176.

Reference: Ross and Evans (1956a).

Range: "British Columbia, Montana, Wyoming, Utah" (McDunnough, 1949); also in mountainous region of Alberta, including the Cypress Hills.

Host: *Juniperus communis* L.

Life History: Larvae, free-living, in June; about 4 weeks usually but occasionally up to 70 days (insectary material) spent in pupal stage; adults in August and September.

Description: *Ultimate*: Head, cuticle, rough; pale brown with brown markings arranged in herring-bone pattern, or pale russet-green, with no markings. Thorax and abdomen, rough, somewhat like *E. cretaceata* (Fig. 96); (two colour phases, brown (a) and green (b)). (a). brown, M.D., dark brown line; L, spiracular stripe brown; subspiracular line yellow below spiracles and white at borders of segments; S.V., chocolate-brown stripe; M.V., white line; prothoracic plate concolorous; anal plate yellow with brown median line and brown patch on each side; legs brown. (b). pale green, with yellow suffusion; M.D., dark green; L, subspiracular whitish-green; venter pale green, with yellowish suffusion; prothoracic plate pale green; anal plate pale rust-colour; legs pale green. Setae short, less than 0.2 mm. in length.

Measurements: H.W., 0.95-1.05 mm.; W/L, 1.33-1.77; B.L., about 14 mm.; B.W., 1.0-1.9 mm.; annulets, 5; ventral proleg with 12-13 crochets, in two groups, and 4 secondary setae. No. of larvae examined: 10.

Remarks: The description of the brown form (a) was prepared from one larva (Forest Insect Survey, Record No. 1952 Alberta 153 C) collected near Lynx Creek, in the Crowsnest Pass of Alberta, on common juniper; the larva was

collected May 18, 1952, pupated June 2, and emerged August 5 as a female. The description of the green form, much commoner in Alberta than the brown, was prepared from one larva (Forest Insect Survey, Record No. 1950 Alberta 90A) also collected in the Crowsnest Pass, on common juniper; collected on June 4, 1950, the larva pupated July 3, and emerged as a female July 29.

E. SOBRINATA INTERRUPTOFASCIATA Packard. Figure in Dietze (1910-1913) Pl. 52. Reference: Fletcher and Gibson (1905); Dietze (1910-1913).

Range: Eastern North America (McDunnough, 1949).

Host: *Juniperus communis* L.

Life History: Overwinters as egg (Forbes, 1948) or perhaps as a larva in the egg shell (Dietze, 1910-1913); larvae free-living (four instars) feed in May in Ontario (Raizenne, 1952) and in June and July in Manitoba; may spend up to three months in pupal stage (Fletcher and Gibson, 1905), or may hibernate as pupae; adults in late August, September, and up to middle of October (Ferguson, 1955a).

Description: I. H.W., 0.43 mm. II. Head, russet-brown. Thorax and abdomen green; subdorsal, supraspiracular, and midventral lines, white; prothoracic plate concolorous; and plate green with white edges; legs pale green. H.W., 0.65 mm.; B.L., 6-7 mm.; B.W., 0.5 mm. III. Head much as in II. Thorax and abdomen much as in II, but anal plate may be russet-green with pale edges. H.W., 0.94-0.97 mm.; B.L., about 10 mm.; B.W., 0.8-1.0 mm. IV. Head, cuticle, rough; pale russet-green. Thorax and abdomen, rough, much as in *E. niphadophilata*; light green; M.D., grey-green line; S.D., white; flanked by grey-green line on ventral side; anal plate green with yellow edges. Setae short.

Measurements: H.W., 1.37-1.46 mm.; W/L, about 1.67; B.L., 10-14 mm.; B.W., 1.0-1.5 mm.; annulets, 5-7; ventral proleg with 12-13 crochets in two groups, and 4 secondary setae. No. of larvae examined: 3.

Remarks: Descriptions of these four stages prepared from larvae (Forest Insect Survey Record No. 1946 Winnipeg 292A and B) collected at Sasaginigak Lake, Manitoba; these larvae were collected late in June, and reared to pupation in August; the pupae hibernated and females emerged when the pupae were incubated in January, 1947.

E. FILMATA Pearsall. Figs. 182, 183, 184, 185 and 187.

References: McDunnough (1942); McGuffin (1945a); Ross and Evans (1956a).

Range: "Eastern United States and Canada, extending westward to Alberta and British Columbia through the so-called spruce belt," (McDunnough, 1949).

Hosts: *Picea* (McDunnough, 1942, found the young larvae feeding on spruce buds, and MacKay, 1951, states that the host is generally spruce). Other occasional host plants are: *Abies*, *Tsuga*, and *Pseudotsuga menziesii* (Mirb.) Franco.

Life History: Near Ottawa, Ontario, eggs laid the latter part of April; eggs hatch in from 8-10 days; larvae, free-living (four instars) feed until end of May; pupation takes place in a light web under spruce needles; hibernate as pupae (McDunnough, 1942); in Alberta, adults in April and May; larvae feed in June and July.

Description: I. Head pale brown. Body pale yellow. II. Much as in I. III. Head pale "fleshy". Body pale yellow with broad brown dorsal and brown lateral stripes, the lower edges of these becoming diffuse in spiracular area;

venter pale. *IV*. The fourth instar larvae present a range of patterns (Figs. 182-185 and 187). In the simplest type (Fig. 182) the pattern is one of lines and in the most elaborate, the pattern consists of a T-shaped marking (Fig. 187). Head, cuticle, rough; light brown or grey, often mottled with brown markings on the parietal lobes. Thorax and abdomen, rough, somewhat as in *E. luteata* (Fig. 95); pale yellow, green, pale brown, brick-red, or brown; M.D., brown or grey, in line, stripe or complex pattern; other markings brown or grey; M.V., usually present as a fine, brick-red line; this line may be broken, prothoracic shield usually concolorous with dorsum, bearing middorsal and subdorsal lines; anal shield ground colour, with pale edges; legs brown, or pale brown or yellow. Setae moderately long, about 0.25 mm. in length.

Measurements: H.W., 0.96-1.24 mm.; W/L, 1.06-1.45; B.L., 12-18 mm.; B.W., 1.0-2.3 mm.; annulets, 6-8; ventral proleg with 9-24 crochets, in two groups, and 4 secondary setae. No. of larvae examined: 15.

E. ANNULATA Hulst.

Reference: Ross and Evans (1956a).

Range: "British Columbia, south to central California, extending eastward in Canada through Alberta to Quebec and the Maritime Provinces and northern Maine," (McDunnough, 1949).

Hosts: MacKay (1951): *Tsuga*, *Abies*, *Picea*, but more often *Pseudotsuga menziesii* (Mirb.) Franco.

Life History: Larvae, free-living, in early summer; hibernate as pupae; adults in April and May.

Description: *Ultimate*: Head, pale brown. Body reddish-brown or yellowish-brown; brown dorsal line, double on thorax; faint cream subdorsal stripe may be present; supraspiracular area reddish-brown; subspiracular fold cream; centre of anal plate concolorous with head, edge cream-coloured.

Measurements: B.L., about 22 mm.

E. CRETACEATA Packard. Figs. 96 and 173.

Range: Very generally distributed wherever the plant, false hellebore, grows; New England states, and across Canada to Vancouver Island; found in the Sierra Nevadas of California (McDunnough, 1949).

Host: *Veratrum viride* Ait. (flowers and seeds).

Life History: Larvae feed in August; probably hibernate as pupae; adults from May until August (Jones, 1951).

Description: *Ultimate*: Head, cuticle rough; black, except clypeal area which is white; thorax and abdomen, rough (Fig. 96); yellow-green; M.D., black, made up of a series of adjacent spots; series of black spots in supraspiracular and spiracular areas; S.V., a series of black spots; M.V., row of elongate black spots (Fig. 173); prothoracic plate black, divided by fine median pale line; anal plate black; thoracic legs black; prolegs brown. Setae moderate, about 0.34 mm. in length, pointed.

Measurements: H.W., 1.17-1.34 mm.; W/L, 1.60-1.75; B.L., about 15 mm.; B.W., about 2.0 mm.; annulets, 5; ventral proleg with 18 crochets scarcely divided into two groups and 4 secondary setae. No. of larvae examined: 2.

E. ALBICAPITATA Packard.

Reference: Ross and Evans (1956a).

Range: In the mountainous district of New York (Catskills) and the New England states and across Canada in the spruce belt (McDunnough, 1949);

in the mountainous region of Alberta, including Cypress Hills (Reid, 1956); and in Yukon Territory (Ross and Evans, 1956a).

Host: *Picea* (cones).

Life History: Larvae, borers, in late July and early August; hibernate as pupae; adults in June and July.

Description: *Ultimate*: Head, cuticle; rough, brown. Thorax and abdomen rough, but not as rough as *E. cretacea* (Fig. 96); flesh-coloured with reddish stripes. Setae moderate, about 0.34 mm. in length.

Measurements: H.W., 1.34-1.50 mm.; W/L, 1.79; B.L., about 10 mm.; B.W., 2.3-2.7 mm.; annulets, 4-5; ventral proleg with 6-11 crochets in one group. No. of larvae examined: 4.

E. MUTATA Pearsall. Figure in Dietze (1910-1913) Pl. 8.

References: Dietze (1910-1913); Ross and Evans (1956a).

Range: Holarctic (Forbes, 1948; Reid, 1956; Jones, 1951).

Host: *Picea* (cones).

Life History: Larvae, borers, in late July and August (Dietze, 1910-1913); hibernate as pupae; adults in June and July.

Description: *Ultimate*: Head, cuticle rough, brown; thorax and abdomen rough, but not as rough as *E. cretacea* (Fig. 96); pale pink or brown, without stripes, and darker on dorsum than on venter. Setae about 0.34 mm. in length.

Measurements: H.W., 1.17-1.25 mm.; W/L, 1.65-1.87; B.L., about 10 mm.; B.W., about 1.9 mm.; annulets, 4; ventral proleg with about 9 crochets in one group, and 4 secondary setae. No. of larvae examined: 2.

E. SPERMAPHAGA Dyar

Range: "Oregon, California, Vancouver Island (?)", (McDunnough, 1949).

Hosts: Keen (1952): *Pseudotsuga menziesii* (Mirb.) Franco, *Abies*, *Tsuga mertensiana* (Bong.) Carr.

Life History: Larvae, borers in cones, probably feed in summer; adults in June.

Description: *Ultimate*: Head, cuticle rough, brown. Thorax and abdomen rough; ground colour probably pale pink, with no lines.

Measurements: H.W., 1.50-2.01 mm.; W/L, 1.20-1.50; B.L., 20-25 mm.; B.W., 3.0-3.8 mm.; ventral proleg with about 15 crochets in one group and 4 secondary setae. No. of larvae examined: 2.

E. RAVOCOSTALIATA Packard

Reference: Ross and Evans (1956a).

Range: "Northern New York and New England states, extending across Canada from the Maritime Provinces to Vancouver Island and down the west coast as far as the San Francisco Bay region", (McDunnough, 1949).

Hosts: Salix; Bird (1927): *Prunus virginiana* L.; Ferguson (1955a): *Viburnum cassinoides* L.

Life History: Larvae, free-living, in June and July; hibernate as pupae; adults in May and June.

Description: *Ultimate*: Head, cuticle, rough; bright green, or pale russet-green; no markings. Thorax and abdomen, rough, much as *E. cretacea* (Fig. 96); green; M.D., blue-green or olive-green; L, subspiracular, yellow or yellow-white line, edged below with red; venter green; prothoracic plate concolorous; anal plate green, yellow at edges; posterior portion of this plate may be suffused with rose colour; paraprocts often rose-coloured; legs green. Setae short, about 0.2 mm. in length.

Measurements: H.W., 1.25-1.50 mm.; W/L, 1.21-1.45; B.L., 15-22 mm.; B.W., 1.5-2.3 mm.; annulets, 6 or 7; ventral proleg with 11-16 crochets in one or two groups, and 4 secondary setae. No. of larvae examined: 8.

E. ANTICARIA Walker. Figs. 4 and 195.

Reference: Ferguson (1955a).

Range: In Canada, from Nova Scotia to Alberta; in the United States, the New England and North Atlantic States, and also Arizona (McDunnough, 1949).

Hosts: Flowers of *Castilleja septentrionalis* Lindl., *Aster*, *Gaillardia*, *Solidago*, and an unidentified species of Labiatae; leaves, and possibly flowers, of *Epilobium*; Ferguson (1955a): flowers of *Spiraea latifolia* (Ait.) Borekh.

Life History: Larvae, free-living, from early August until middle of September; hibernates as pupae; adults from May until early August.

Description: *Ultimate*: Head, cuticle rough; pale green, with no markings. Thorax and abdomen rough; as in *E. luteata* (Fig. 95); green or pale green; M.D., geminate, pale grey line; L. subspiracular line red; M.V., pale stripe; prothoracic plate green; anal plate green with rose-coloured suffusion; legs green. Setae moderate, about 0.20 mm. in length.

Measurements: H.W., 0.82-0.97 mm.; W/L, 1.09-1.29; B.L., 16-21 mm.; B.W., 1.0-1.3 mm.; annulets, 6; ventral proleg with about 10 crochets in two groups and 4 secondary setae. No. of larvae examined: 4.

Ross and Evans (1956a) have published brief but very useful biological and descriptive notes on a number of species of *Eupithecia*; those that have not come under the species above are mentioned below.

E. COLUMBRATA McDunnough

Additional Reference: Reid (1956).

Range: Southern British Columbia and adjacent regions in Washington (McDunnough, 1949).

Hosts: Cones of *Picea sitchensis* (Bong.) Carr.; Reid (1956): cones of *Abies lasiocarpa* (Hook.) Nutt.

Description: *Larva*: pale orange-brown, shaded darker on the dorsum. A borer in cones.

E. GEORGI McDunnough

Range: British Columbia and Pacific coast states, Utah, southwestern Colorado (McDunnough, 1949).

Hosts: *Betula papyrifera* Marsh., *Ceanothus*.

Description: *Larva*: Pale brown; double dorsal line expanding into diamond pattern.

E. GRAEFI VANCOUVERATA Taylor

Range: British Columbia to Alaska (McDunnough, 1949).

Hosts: *Arbutus menziesii* Pursh., *Thuja plicata* Donn., *Pseudotsuga menziesii* (Mirb.) Franco.

Description: *Larva*: Variable yellow-green; red dorsal stripe; red spiracular line sometimes present.

E. HARRISONATA MacKay

Range: Southern coast of British Columbia and Vancouver Island.

Hosts: *Tsuga heterophylla* (Raf.) Sarg., *Abies*, *Pseudotsuga menziesii* (Mirb.) Franco, *Picea glauca* (Moench.) Voss.

Description: *Larva*: Apparently there are two colour phases: one is velvety green and the other is reddish-brown. Both phases have a dark dorsal line with a pale edging; fine dark subdorsal lines; yellow subspiracular lines; dark venter, usually light subventral lines.

E. LONGIPALPATA Packard

Range: Pacific coast states and British Columbia (McDunnough, 1949).

Hosts: *Tsuga*, *Pseudotsuga menziesii* (Mirb.) Franco, *Abies grandis* (Doug.) Lindl., *Picea sitchensis* (Bong.) Carr., *Pinus*, *Thuja plicata* Donn.

Description: *Larva*: Head and body yellowish-green; dark dorsal line; pale subdorsal lines sometimes present; yellow spiracular line.

E. MAESTOSA MAESTOSA Hulst.

Range: General throughout the Rocky Mountain and Pacific coast states, extending north into British Columbia (McDunnough, 1949).

Host: *Alnus*.

Life History: Larvae feed in July; hibernate as pupae.

Description: *Larva*: Greenish-yellow.

E. OLIVACEA Taylor

Range: Vancouver Island and adjacent regions of the mainland of British Columbia; Oregon (McDunnough, 1949).

Hosts: *Pseudotsuga menziesii* (Mirb.) Franco, *Tsuga heterophylla* (Raf.) Sarg., *Abies*.

Description: *Larva*: Head pale brown; body yellowish-brown with darker diagonal markings along dorsum.

E. ROTUNDOPUNCTA Packard

Range: Pacific coast states, north to Prince Rupert and the Queen Charlotte Islands of British Columbia (McDunnough, 1949; Ross and Evans, 1956a).

Host: *Salix*.

Description: *Larva*: Head brown; body pale brown, with broken brown lines on dorsum.

E. UNICOLOR Hulst.

Range: California to British Columbia.

Hosts: *Pseudotsuga menziesii* (Mirb.) Franco, *Tsuga heterophylla* (Raf.) Sarg., *Thuja plicata* Donn.

Life History: Larvae from May 4 to July 12; adults emerged in insectary from June 18 to August 11; Jones (1951) reports adults may be found from May until September.

Description: *Larva*: A twig mimic somewhat similar to *E. placidata*.

E. VINSULLATA MacKay

Range: Southern interior of British Columbia.

Host: *Pseudotsuga menziesii* (Mirb.) Franco.

Description: *Larva*: Body, pale brown or yellow; dark dorsal line, fine lateral line, light spiracular line.

E. USURPATA Pearsall.

Range: British Columbia (McDunnough, 1949).

Hosts: *Abies*, *Tsuga heterophylla* (Raf.) Sarg., *Thuja plicata* Donn.

Description: *Larva*: Head, bright tan; variegated brown diagonal pattern on body; irregular yellow spiracular line.

Tribe *Lobophorini*

NYCTOBIA Hulst

N. LIMITARIA Walker. Figs. 7, 22, 58, 73, 78, 99, 121, 127, 185 and 200.

Reference: McGuffin (1945b).

Range: Transcontinental.

Hosts: *Picea*, *Abies*, *Larix*, *Tsuga*, *Pseudotsuga menziesii* (Mirb.) Franco.

Life History: Eggs laid on new growth of host in spring; larvae, free-living (four instars) from middle of May until middle of August; pupae hibernate; adults from April to June.

Description: *I.* Head, thorax and abdomen yellow. H.W., 0.48 - 0.50 mm.; B.L., 5 mm. *II.* Head, thorax and abdomen yellow-green; H.W., 0.75 - 0.88 mm.; B.L., 10 mm.; B.W., 1.0 mm. *III.* Head pale yellow-green. Thorax and abdomen yellow-green; M.D., green; S.D., yellow line; L, subspiracular line yellow; M.V., pale line; H.W., 1.1 - 1.2 mm.; B.L., 12 mm.; B.W., 1.2 mm. *IV.* Head, cuticle, rough; pea-green; unmarked. Thorax and abdomen, roughened (Fig. 99); green; segments of abdomen moniliform in appearance; S.D., yellow-green; L, yellow subspiracular line; M.V., pruinose-green stripe; prothoracic plate yellow-green anteriorly and pea-green posteriorly; anal plate green, margined with yellow; thoracic legs green proximally, yellow-green distally; prolegs green. Setae short, pale or dark in colour, blunt-tipped.

Measurements: H.W., 1.50 - 1.90 mm.; W/L, 1.35 - 1.55; B.L., 13 - 19 mm.; B.W., 1.6 - 2.0 mm.; annulets, 5; ventral proleg with 8 - 18 crochets, in two groups, and 4 secondary setae. No. of larvae examined: 10.

LOBOPHORA Curtis

KEY TO SPECIES (Mature Larvae)

Occurs from Nova Scotia to eastern Alberta *L. nivigerata*
Occurs in western Alberta and British Columbia *L. magnoliatoidata*

L. NIVIGERATA Walker

Range: Nova Scotia, west to eastern Alberta (Bowman, 1951); Massachusetts, New York, Minnesota (Forbes, 1948).

Host: *Populus tremuloides* Michx.

Life History: Larvae, free-living; (five instars) from June 19 until August 10; hibernate as pupae; adults in June and July.

Description: *I.* Head, pale in colour. Thorax and abdomen yellow; H.W., 0.27 mm.; B.L., about 4 mm.; B.W., about 0.3 mm. *II.* Head pale green. Thorax and abdomen pale green with fine pale lines in subdorsal and spiracular regions; paraprocts conspicuous by great length; intersegmental areas yellow. H.W., 0.43 - 0.48 mm.; B.L., about 7 mm.; B.W., about 0.7 mm. *III.* Head, thorax, and abdomen with pattern much as in *II.* H.W., 0.72 - 0.81 mm.; B.L., 7 - 9 mm.; B.W., 0.5 - 0.9 mm. *IV.* Head, thorax and abdomen with pattern much as in *III*; paraprocts long, conspicuous; H.W., 1.15 - 1.23 mm.; B.L., 13 - 16 mm.; B.W., 1.2 - 1.5 mm. *V.* Head, cuticle rough, pale yellow-green, with or without light brown flecks. Thorax and abdomen slightly roughened, grey-green or pruinose-green; prominent yellow line ventrad of Dorsal setae; very fine yellow line through spiracles; plates concolorous; legs grey-green or pruinose-green. Setae short, pale in colour, blunt-tipped.

Measurements: H.W., 1.72 - 1.90 mm.; B.L., 16 - 20 mm.; B.W., 1.5 - 2.0 mm. No. of larvae examined: 7.

L. MAGNOLIATOIDATA Dyar. Figs. 9, 186, and 201.

Range: Alberta and British Columbia.

Host: *Populus tremuloides* Michx.

Life History: Eggs laid in spring; about 15 days in egg stage; larvae, free-living (five instars) from middle of June until middle of August; hibernate as pupae; adults in May, June, and July.

Description: *I.* Head pale brown. Thorax and abdomen whitish in early part of instar but later pale green with conspicuous yellow intersegmental areas; thoracic area may be pale brown; paraprocts long and conspicuous, H.W., 0.30 - 0.32 mm.; B.L., about 3.4 mm.; B.W., about 0.3 mm. *II.* Pattern of head, thorax and abdomen, as in late instar larvae of first stage; paraprocts large and long. H.W., 0.48 - 0.52 mm.; B.L., about 2.7 mm. *III.* Larvae pale green with pale line in subdorsal position. H.W., 0.75 - 0.80 mm.; B.L., about 8.0 mm. *IV.* Pattern as in third instar. H.W., 1.08 - 1.17 mm.; B.L., about 10 mm. *V.* Head, cuticle rough; blue-green; with no markings. Thorax and abdomen slightly roughened, pruinose; blue-green, segments of abdomen moniliform in appearance; S.D., yellow line; L, fine yellow spiracular line; M.V., fine pale line; venter pruinose; plates concolorous with body; paraprocts long, may be rose-coloured at tips; thoracic legs pale russet colour; prolegs concolorous with abdomen. Setae short, pale in colour, blunt-tipped.

Measurements: 1.52 - 2.00 mm.; W/L, 1.48 - 1.65; B.L., 20 - 22 mm.; B.W., about 2.0 mm.; annulets, 3 - 6; ventral proleg with 12 - 14 crochets in two groups, and 4 secondary setae. No. of larvae examined: 15.

Remarks: Descriptions prepared from the progeny of one gravid female, captured on the Kananaskis Forest Experiment Station, Seebe, Alberta; the larvae appeared to be much like those of *L. nivigerata* Walker.

Tribe Eudulini

EUDULE Hübner

E. MENDICA Walker. Figs. 20, 56, 69, 79, 101, 102, 120, 125, 187, and 198.

Reference: Dyar (1901a).

Range: Transcontinental.

Host: *Viola*.

Life History: Eggs laid in late May or June in eastern United States (Dyar, 1901a); larvae (four instars) may be found in late May in New York; adults in June and July.

Description: *I.* Head black. Thorax and abdomen "sordid yellowish white; after eating, sordid greyish green"; at the end of the stage a broad irregularly powdered subdorsal band appears. *II.* Head black, paler on the apices of the parietal lobes. Thorax and abdomen whitish, faintly green from the food; a broad, diffuse purple-brown subdorsal band. H.W., 0.6 mm. *III.* Head black, white above clypeus (Dyar's term), and in an erect line to top of each lobe, joined by a transverse bar above clypeus. Thorax and abdomen white, speckled by black tubercles, shading to pale slate grey dorsally and ventrally; dorsum irregularly speckled with brown, forming a diffuse subdorsal band; all legs white. *IV.* Head, cuticle rough (Fig. 102); pale grey with grey and dark grey or black markings. Thorax and abdomen rough; flesh-coloured, shaded with green and sparsely brown-dotted. Setae short, dark, and pointed.

Measurements: H.W., 1.43 - 1.52 mm.; W/L, 1.36 - 1.55; B.L., 25 - 33 mm.; B.W., 1.0 - 2.0 mm.; annulets, 12 - 16; ventral proleg with about 10 crochets in two groups, and 4 secondary setae. No. of larvae examined: 4.

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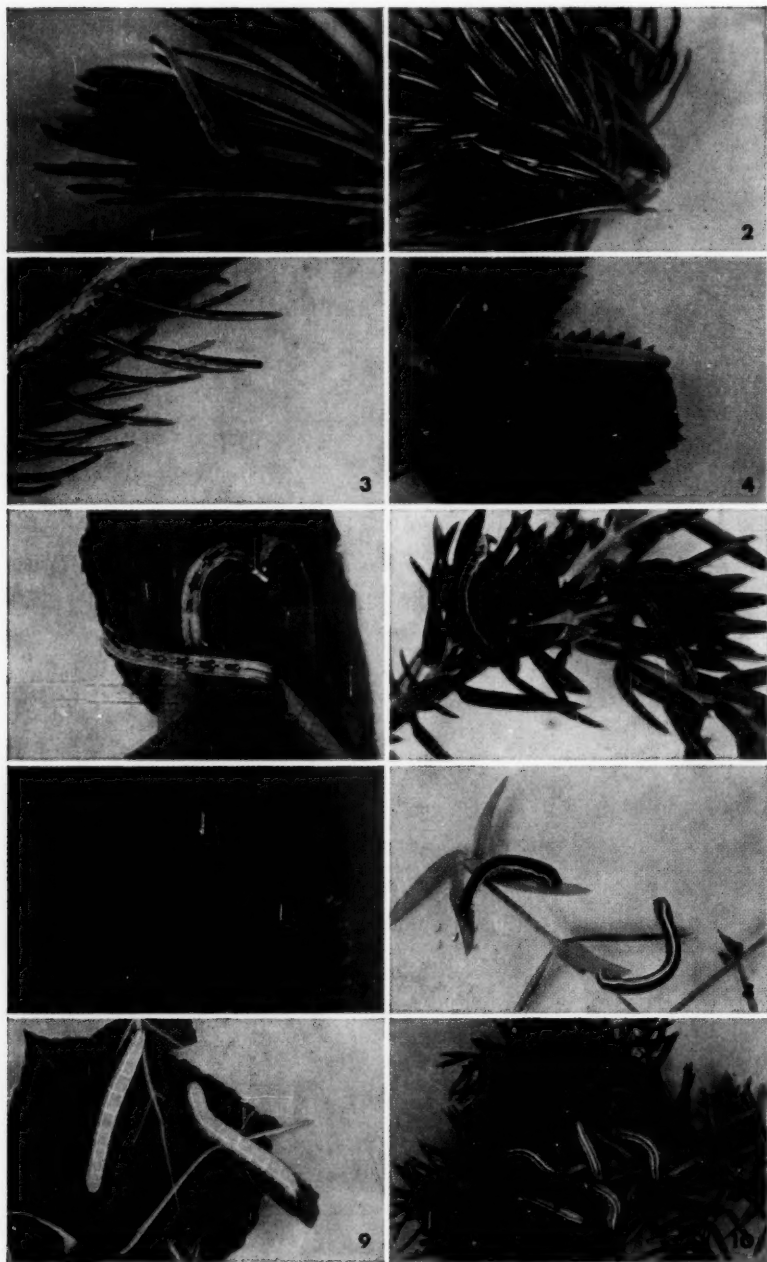
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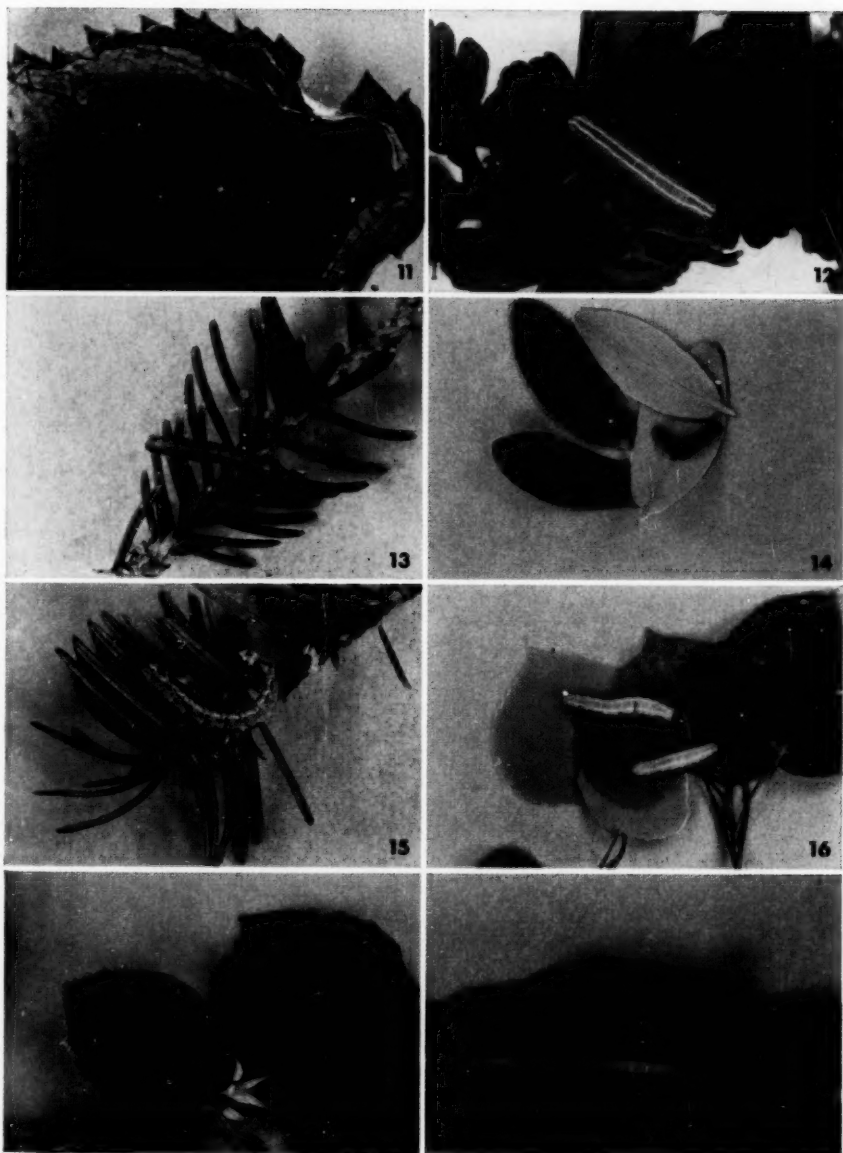
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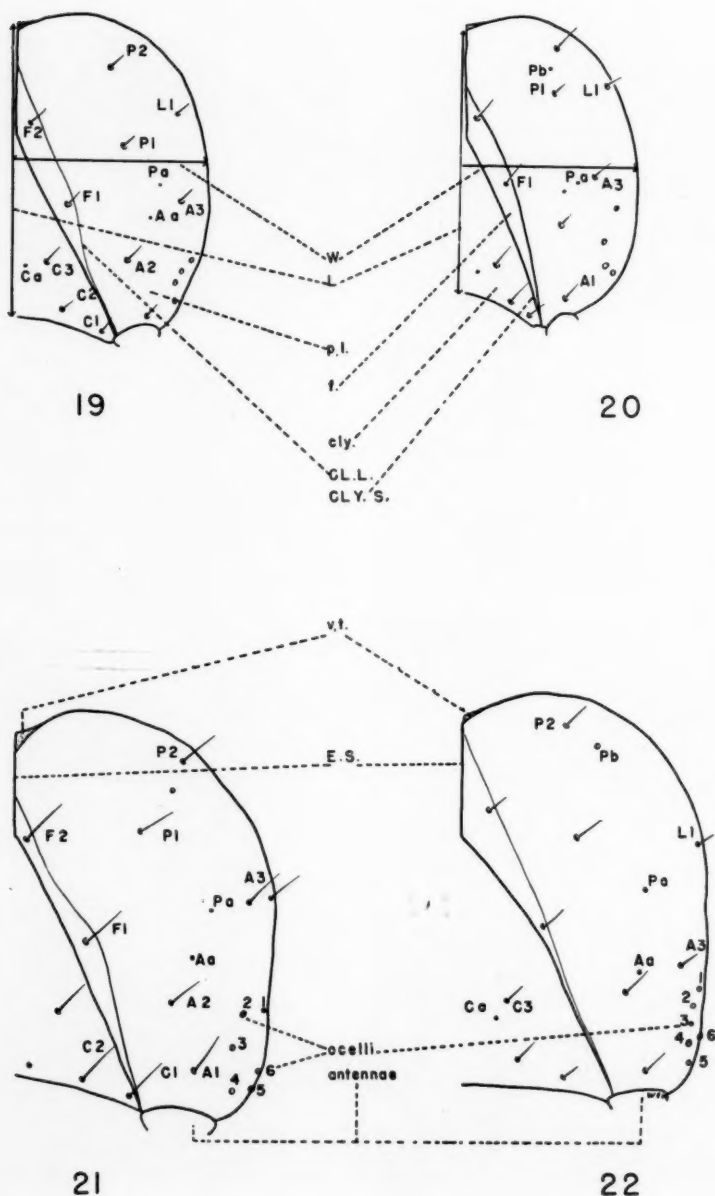
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Figs. 1-10. Coloured figures of living larvae. 1, *Eupithecia palpata* Pack; 2, *E. luteata* Pack; 3, *E. kasloata* Taylor; 4, *E. anticaria* Wlk.; 5, *Horisme intestinata* Gn.; 6, *Eupithecia niphadophilata* Dyar; 7, *Nyctobia limitaria* Wlk.; 8, *Epirrhoe speyeri* Herbt; 9, *Lobophora magnoliatoidata* Dyar; 10, *Thera otisi* Dyar.



Figs. 11-18. Coloured figures of living larvae. 11, *Rheumaptera* sp. prob. *bastata* L; 12, *Dysstroma* sp. prob. *ethela* var; 13, *Hydromena albimontanata* McD.; 14, *H. furcata* Ferg; 15, *H. divisa* Wlk; 16, *Operophtera bruceata* Hlst; 17, *Epirrita autumnata omisa* Harr; 18, *Spargania luctuata obductata* Moesch.



Figs. 19-22. Frontal aspect of head, left half. 19, *Thera otisi* Dyar; 20, *Eudule mendica* Wlk; 21, *Hydriomena furcata* Borg; 22, *Nyctobia limitaria* Wlk. CL.L. Cleavage line; CLY.S. Clypeofrontal suture; E.S. Epicranial stem; cly. clypeus; f. frons; p.l. parietal lobe; v.t. vertical triangle; W. Width (one-half); L. Length.

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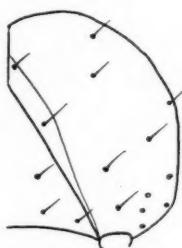
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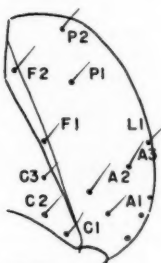
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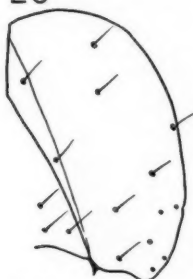
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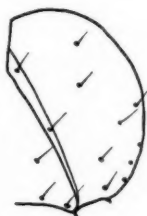
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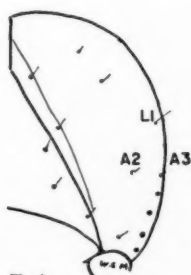
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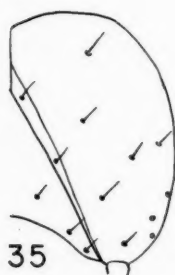


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Figs. 23-34. Frontal aspect of head—left half. 23, *Operophtera bruceata* Hlst; 24, *Hydrelia albifera* Wlk; 25, *Venusia pearsalli* Dyar; 26, *Calocalpe undulata* L; 27, *Rbeumaptera* sp. prob. *hastata* L; 28, *Triphosa baesitata* Gn; 29, *Euphyia multiferata* Wlk; 30, *Spargania magnoliata* Gn; 31, *Mesoleuca gratulata* Wlk; 32, *Epirrhoe alternata* Mull; 33, *Earophila vasilata* Gn; 34, *Stammoctenis morrisata* Hlst.



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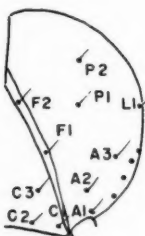
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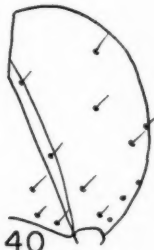
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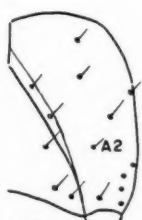
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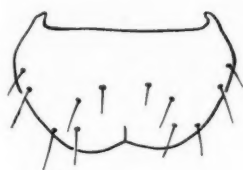
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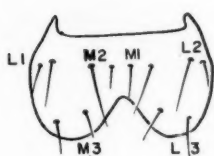
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Figs. 35-46. Frontal aspect of head—left half. 35, *Camptogramma stellata* Gn; 36, *Xanthorbhoe packardata* McD; 37, *Zenopheps lignicolorata* Pack; 38, *Percnoptilota obstipata* Fabr; 39, *Eustroma semiatrata* Hlst; 40, *Lygris propulsata* Hlst; 41, *Ceratodalia gueneata* Pack; 42, *Trichodezia albobittata* Gn. 43, *Diactinia silaceata albolineata* Pack; 44, *Plemyria georgii* Hlst; 45, *Horisme intestinata* Gn; 46, *Eupithecia luteata* Pack.

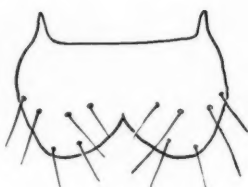
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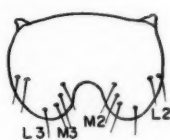
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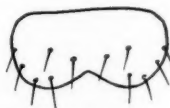
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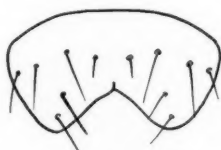
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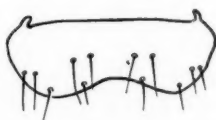
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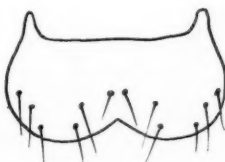
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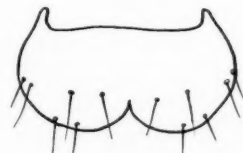
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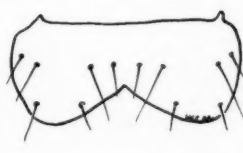
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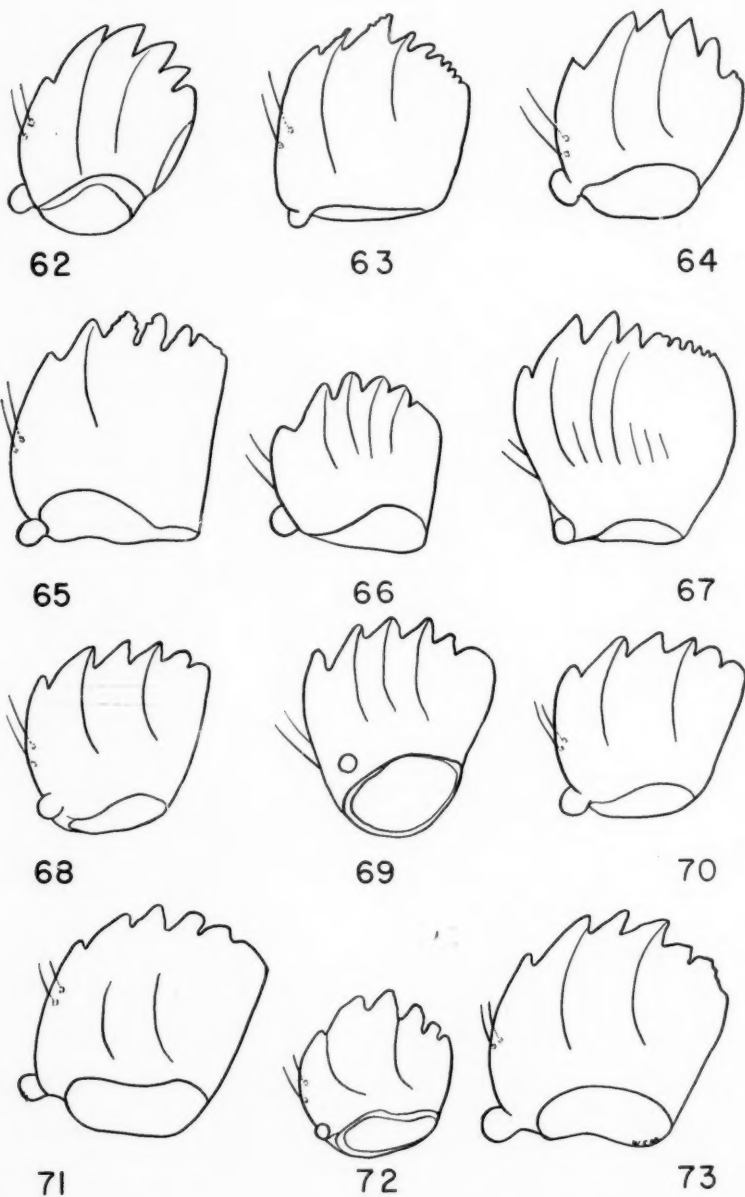


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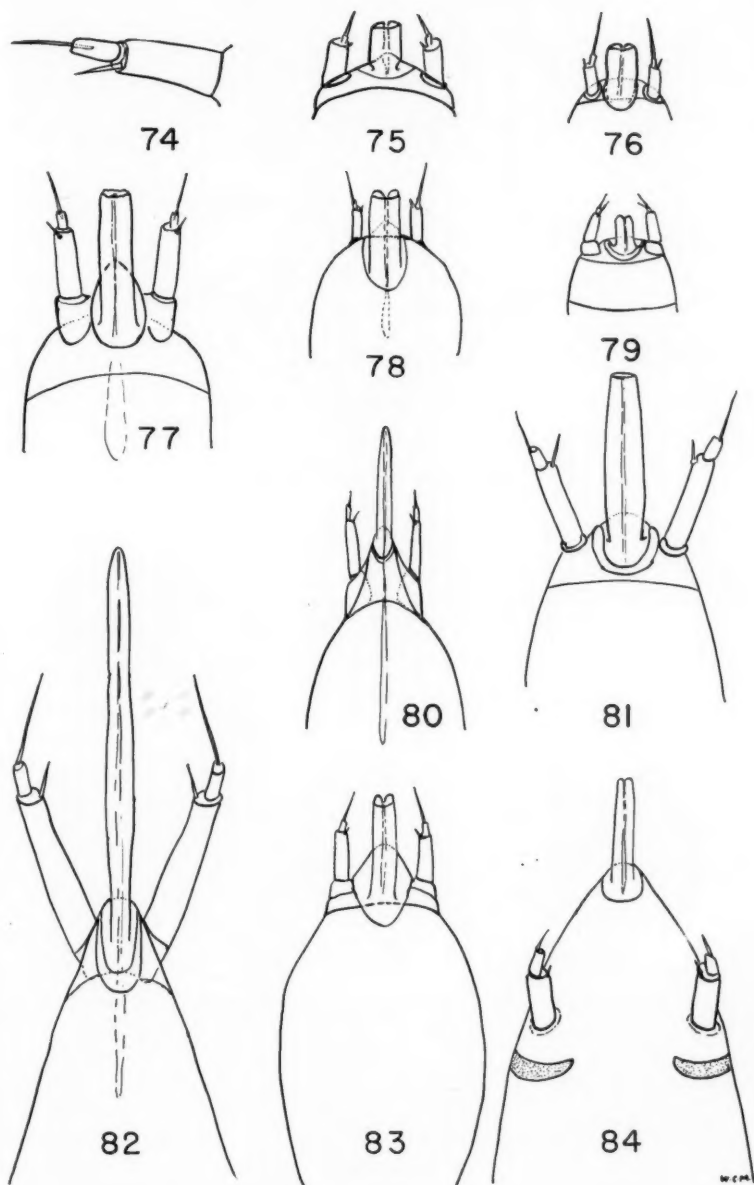
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Figs. 47-61. Labra. 47, *Eupithecica gibsonata* Tayl; 48, *Horisme intestinata* Gn; 49, *Hydriomena furcata* Borg; 50, *Thera otisi* Dyar; 51, *Dysstroma* sp. prob *ethela* var; 52, *Lygris propulsata* Wlk; 53, *Coryphista meadi* Pack; 54, *Epirrita autumnata omissa* Harr; 55, *Operophtera bruceata* Hlst; 56, *Eudule mendica* Wlk; 57, *Stammnoctenis morrisata* Hlst; 58, *Nyctobia limitaria* Wlk; 59, *Xanthorhoe ferrugata* f. *unidentaria* Haw; 60, *Venusia pearsallii* Dyar; 61, *Epirrhoe alternata* Mull.

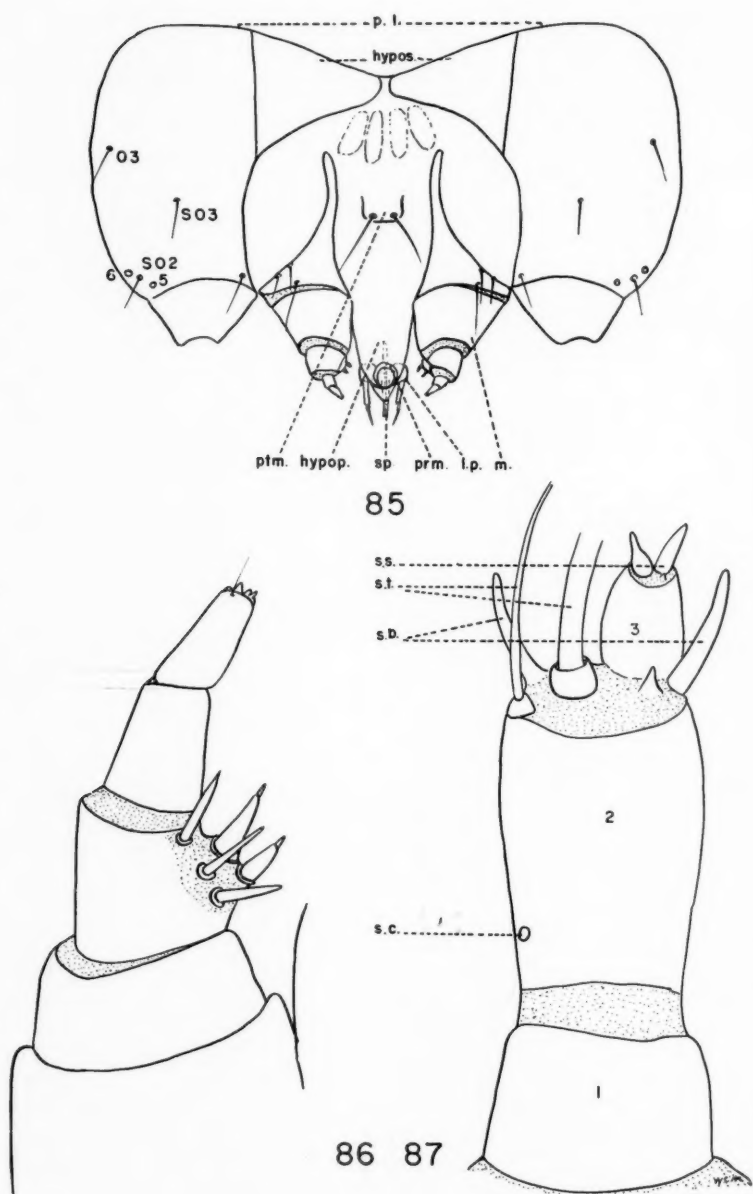


Figs. 62-73. Mandibles-inner aspect of left. 62, *Operophtera bruceata* Hlst; 63, *Lygris propulsata* Wlk; 64, *Epirrita autumnata omissa* Harr; 65, *Trichodezia albovittata* Gn; 66, *Thera otisi* Dyar; 67, *Epirrhoe alternata* Mull; 68, *Eupithecia luteata* Pack; 69, *Eudule mendica* Wlk; 70, *Eupithecia gibsonata* Tayl; 71, *Hydriomena furcata* Borg; 72, *Percnoptilota obstipata* Fabr; 73, *Nyctobia limitaria* Wlk.

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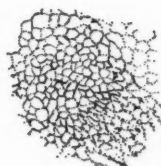
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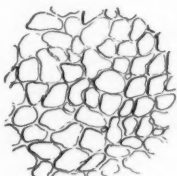
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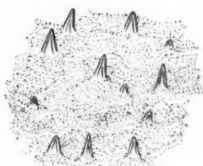
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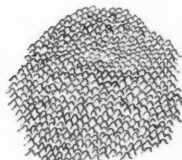
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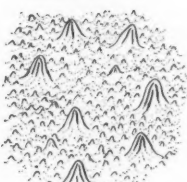
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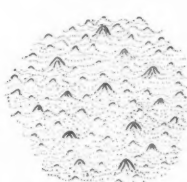
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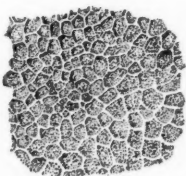
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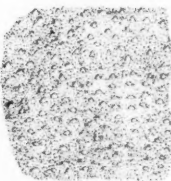
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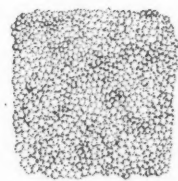
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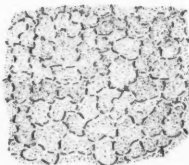
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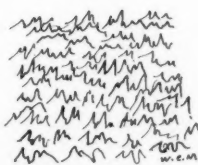
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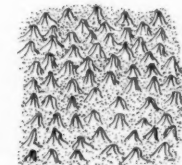
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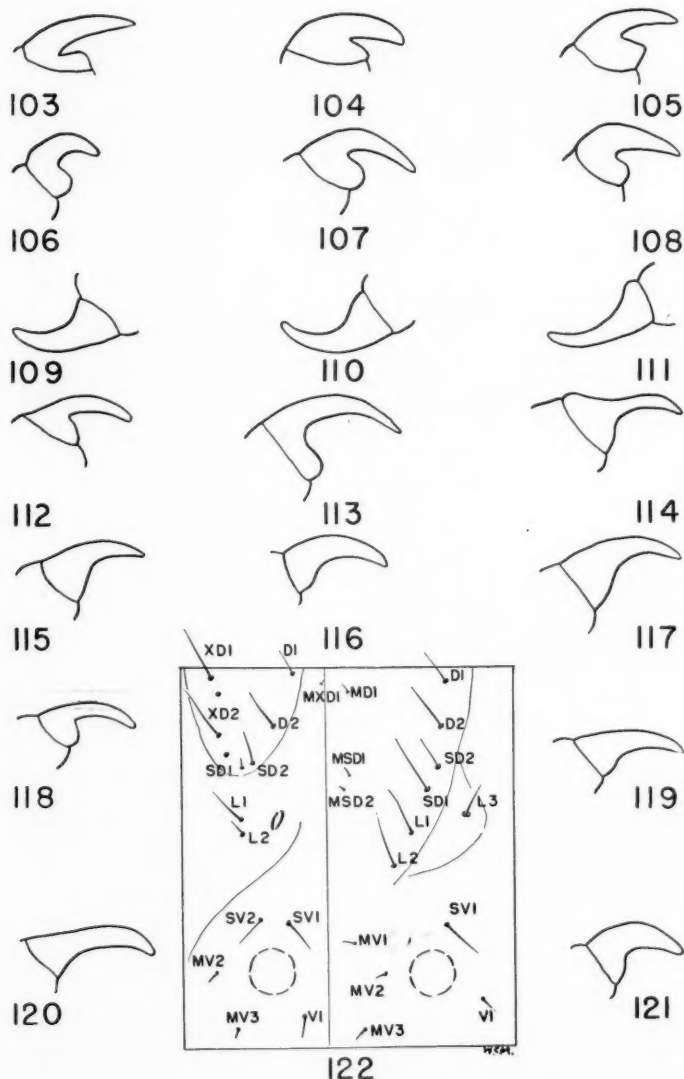


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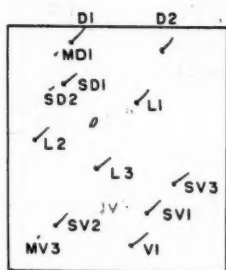


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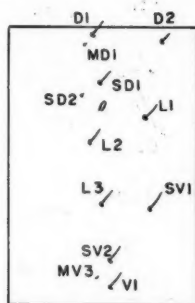
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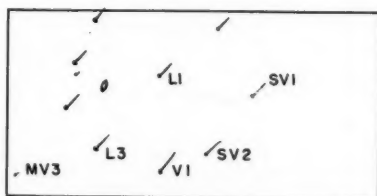
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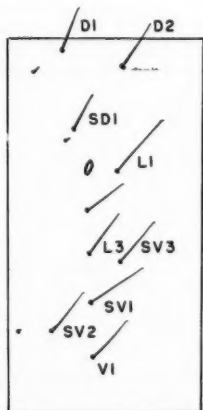
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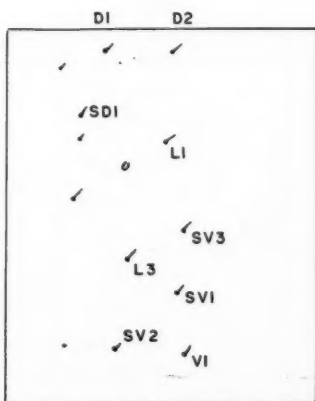
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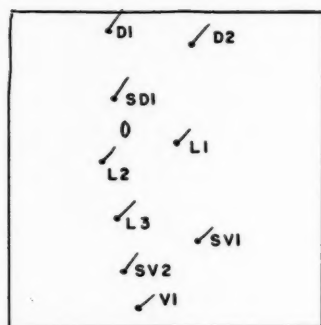


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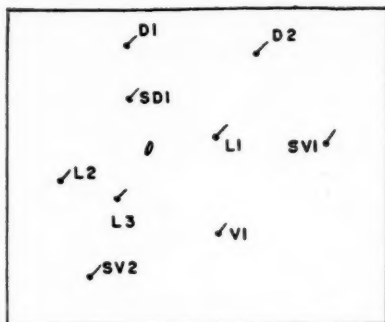


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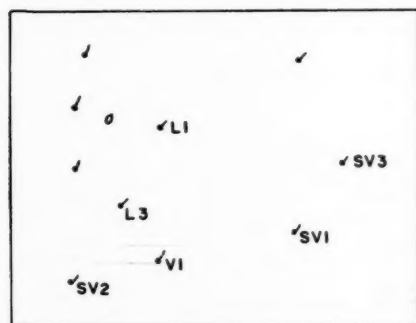
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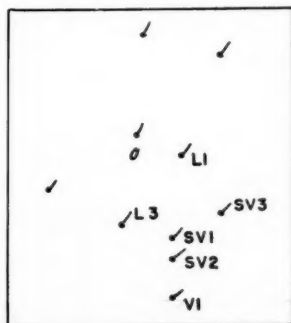
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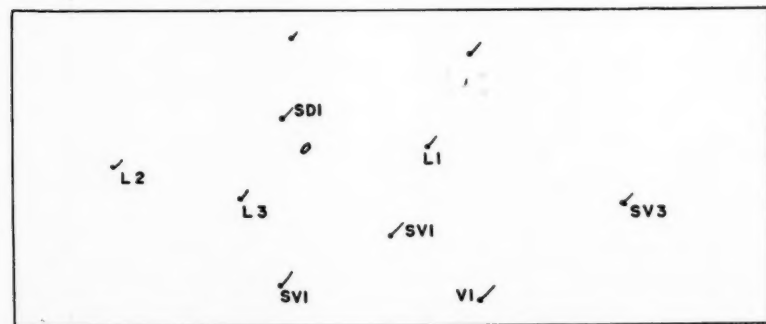
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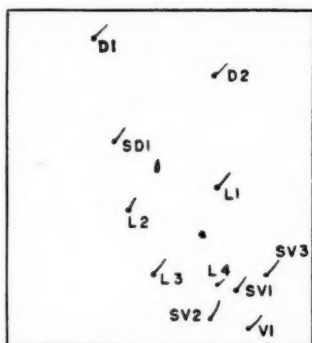


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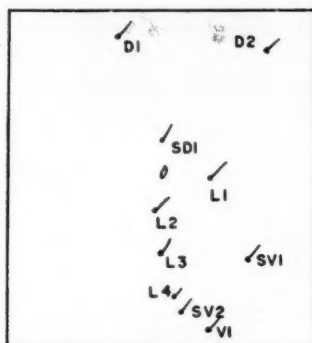


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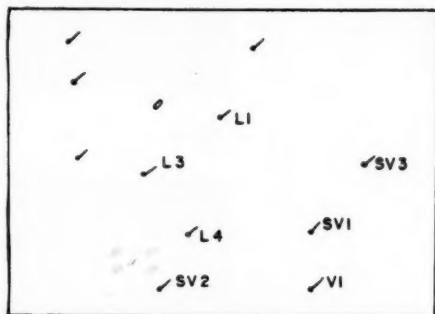
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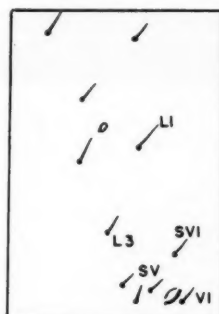
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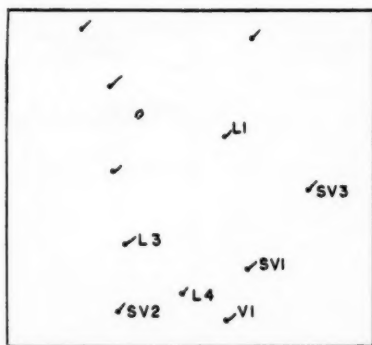
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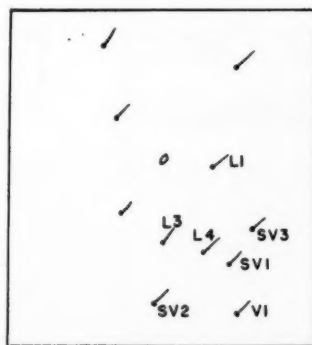
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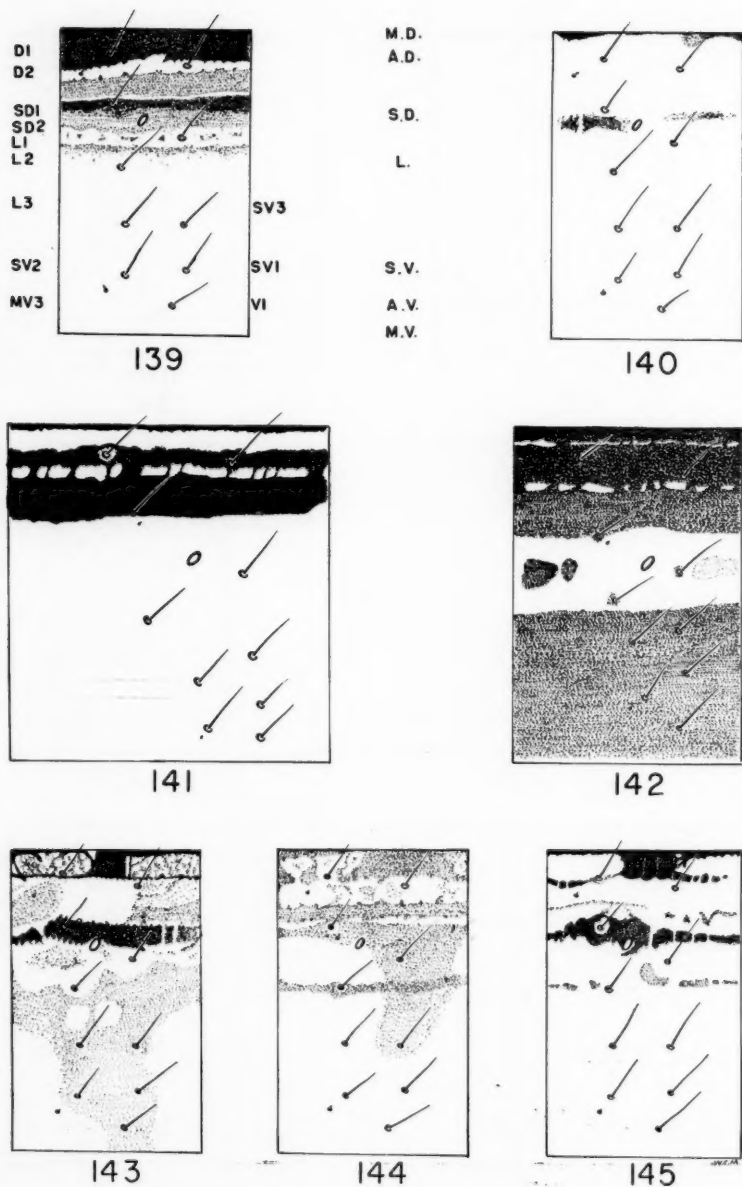


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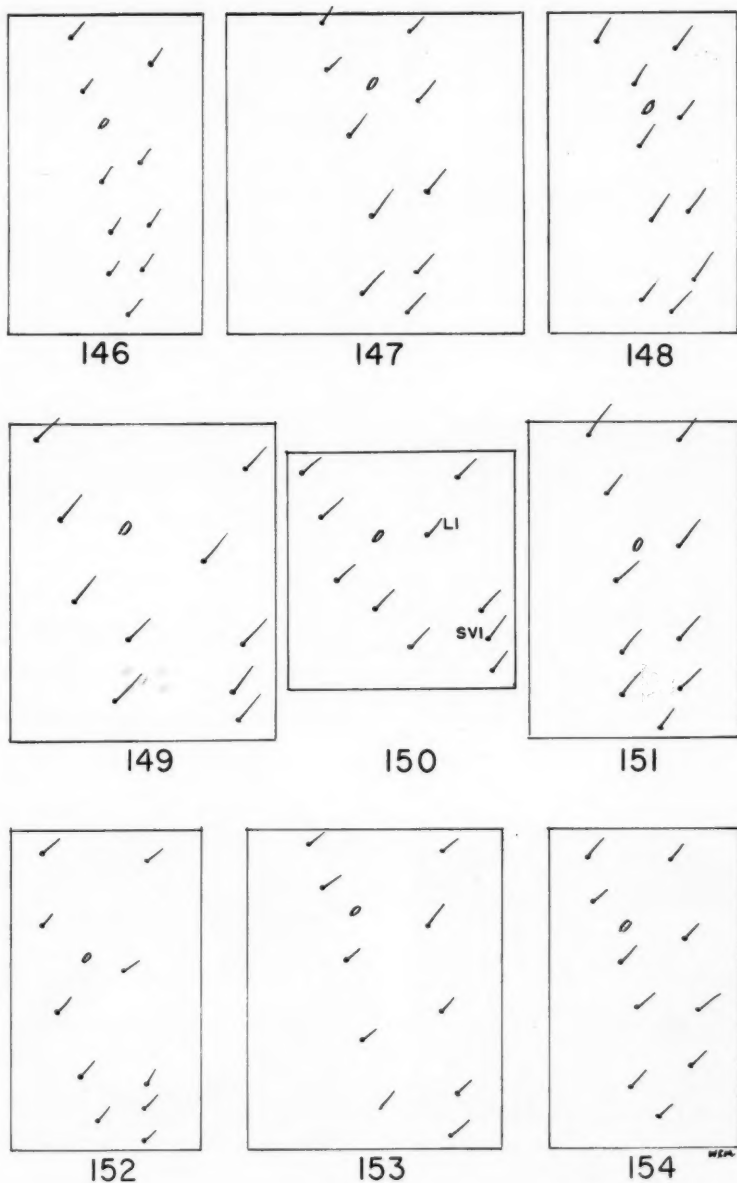


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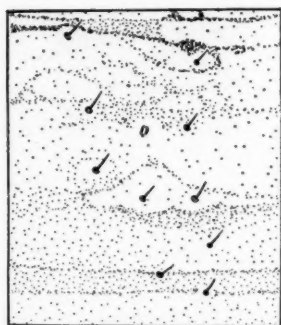
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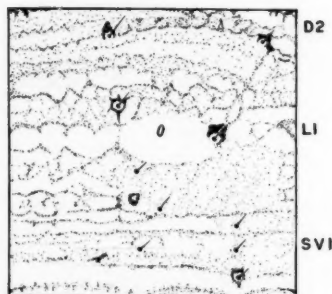
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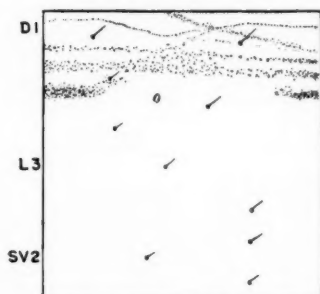
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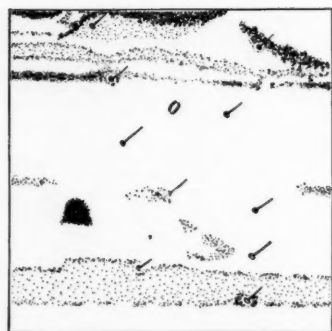
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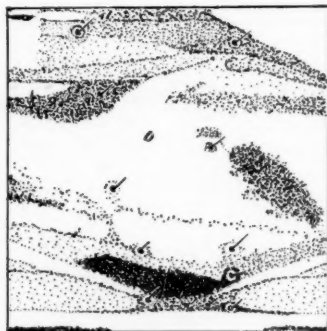
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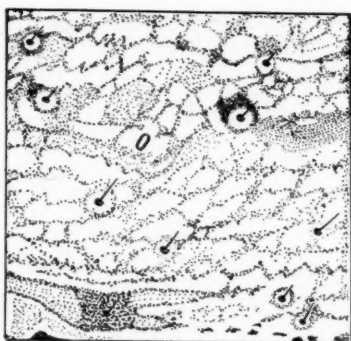


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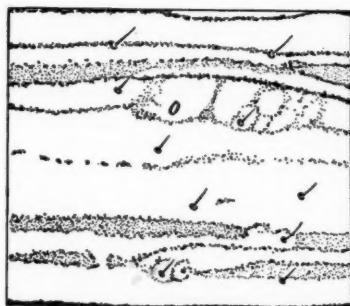
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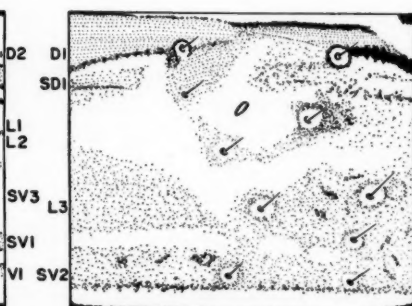
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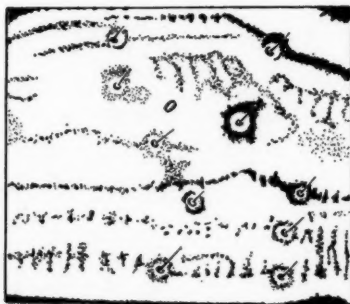
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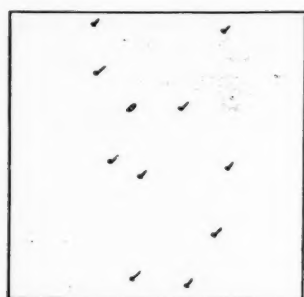


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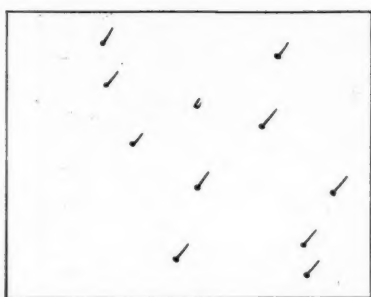


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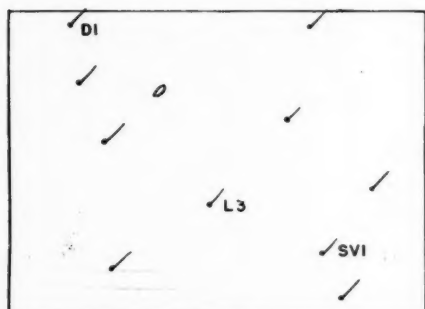
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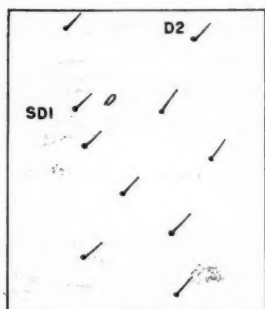
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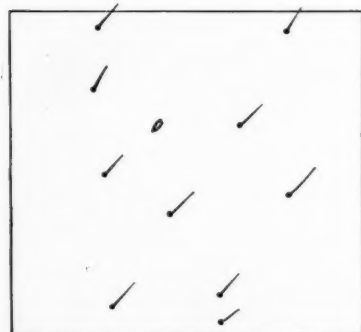
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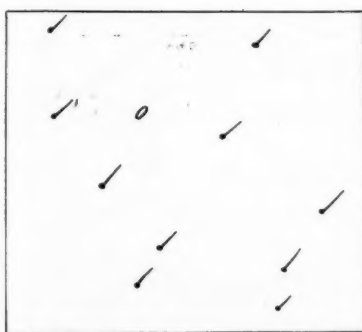
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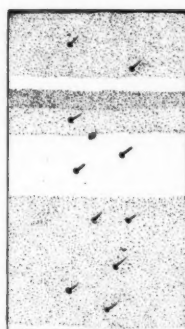
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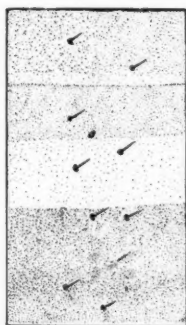
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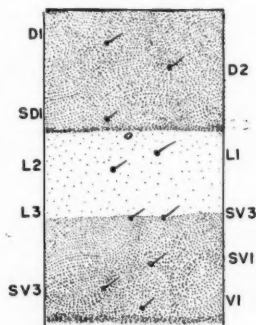
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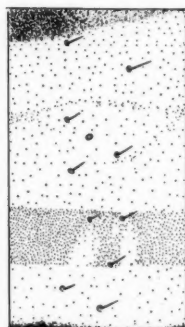
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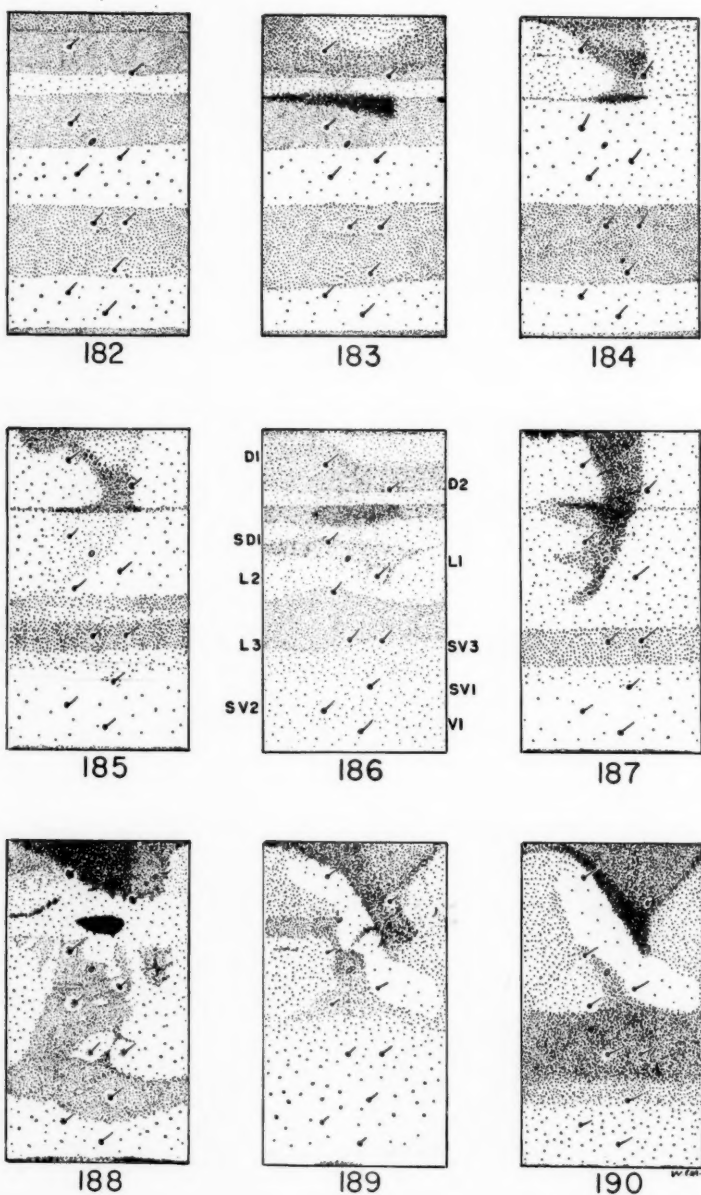


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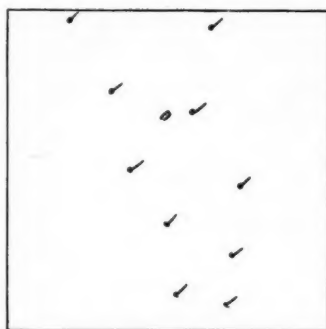


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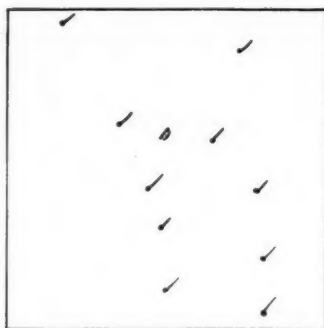
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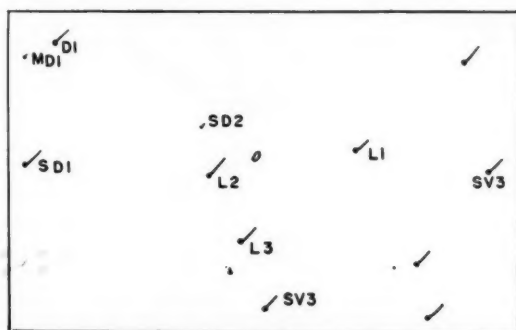
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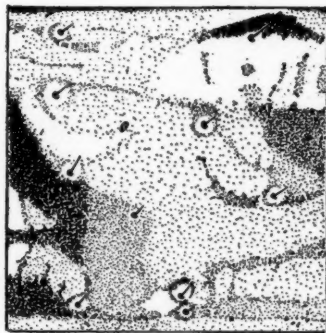
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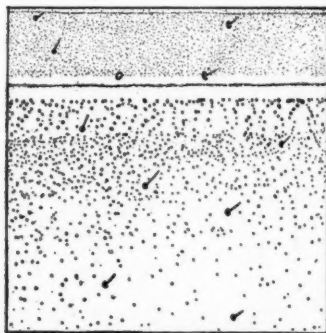
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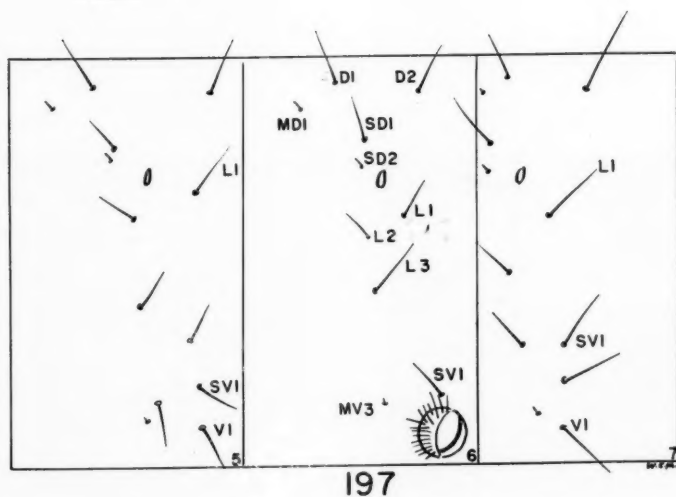
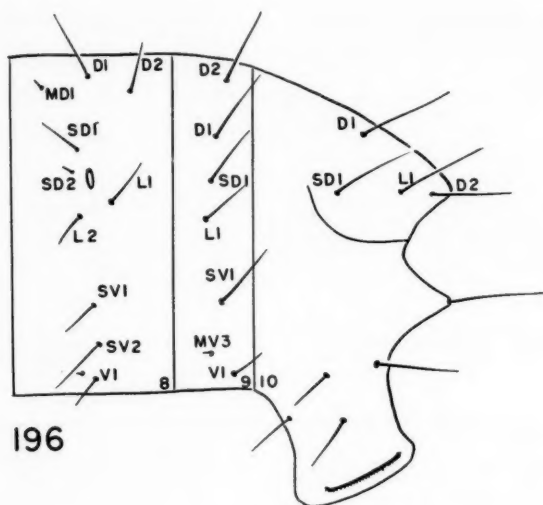


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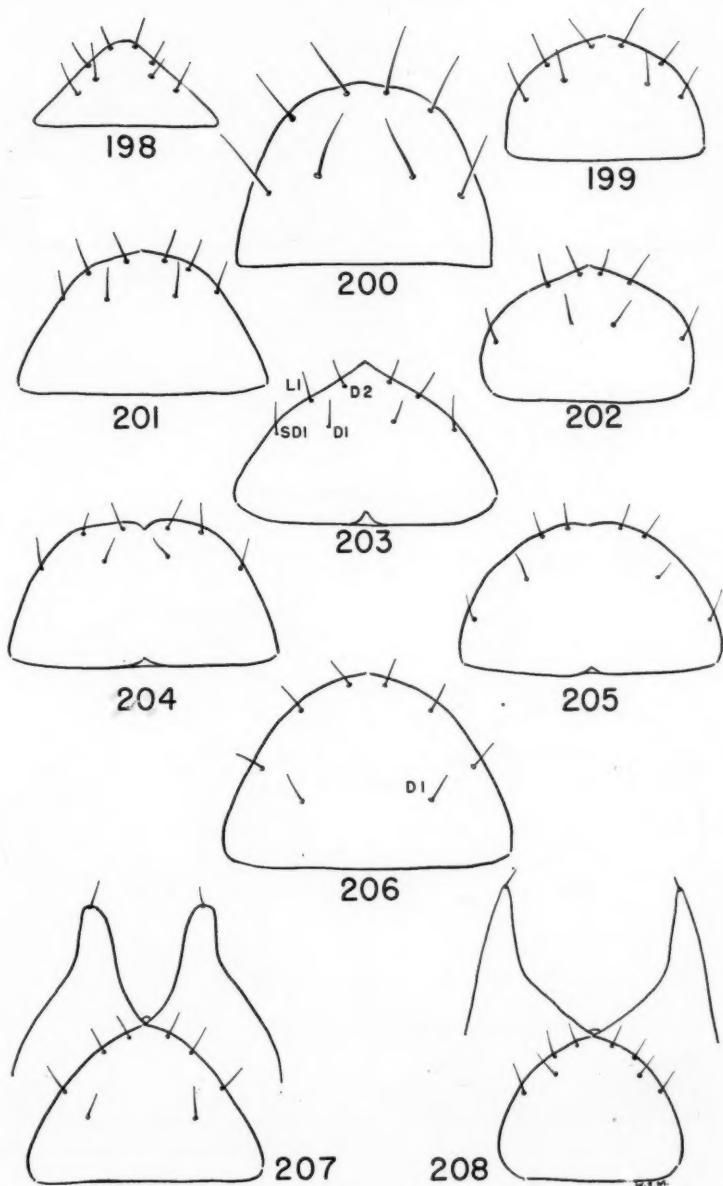


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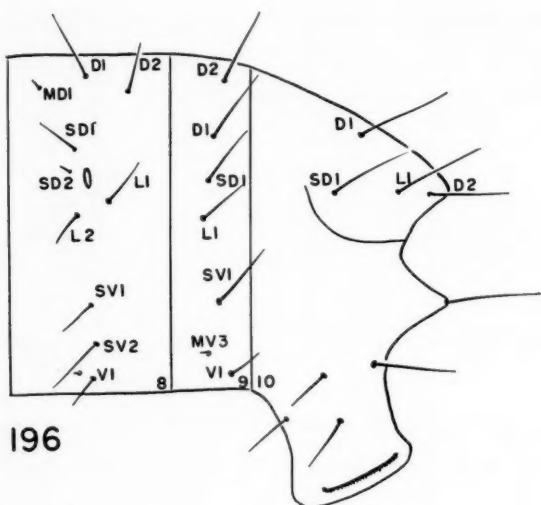
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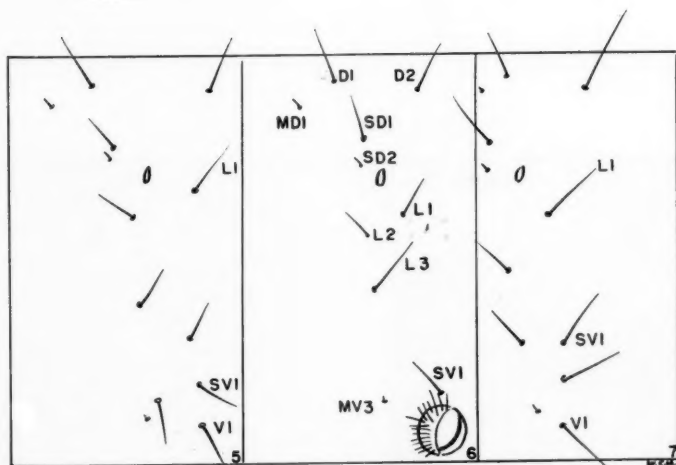
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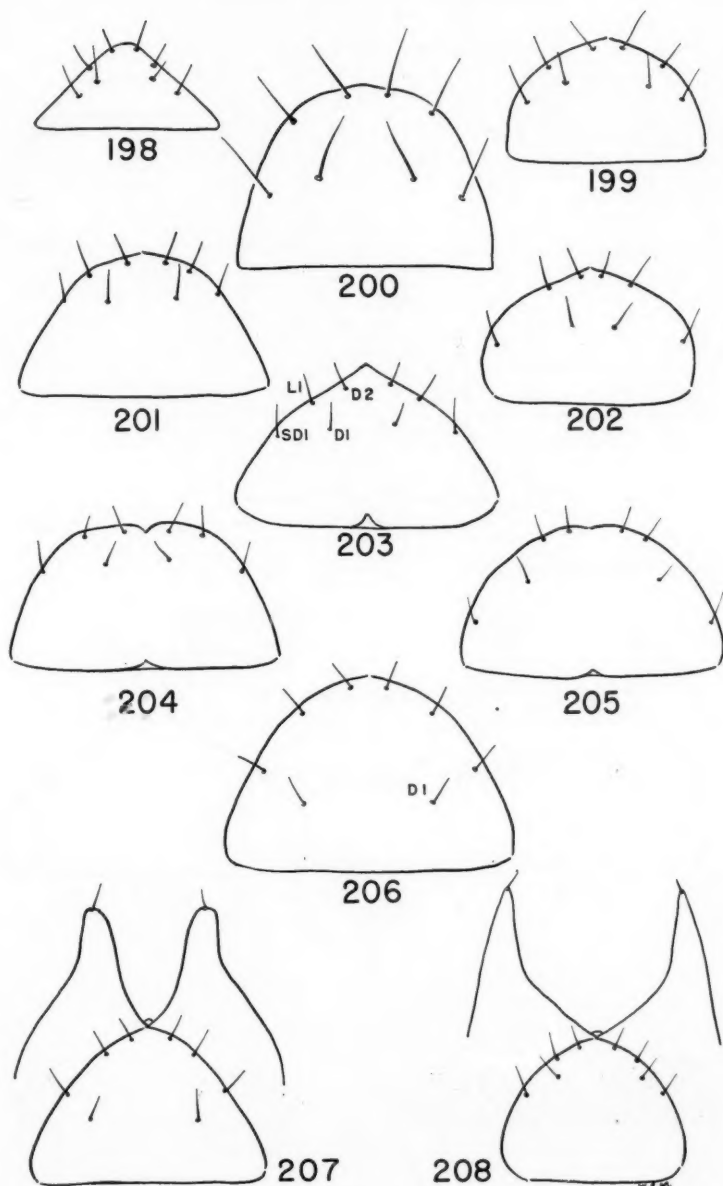


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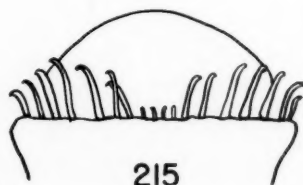
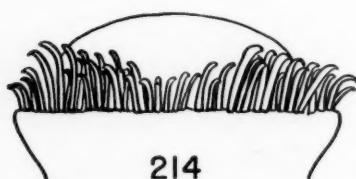
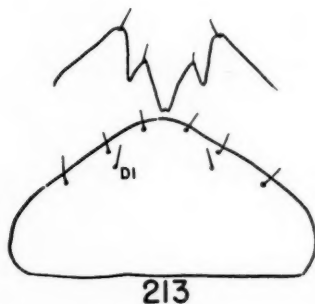
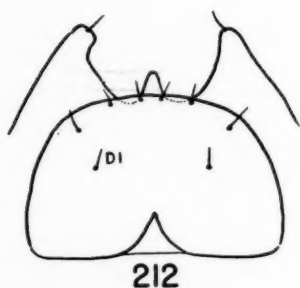
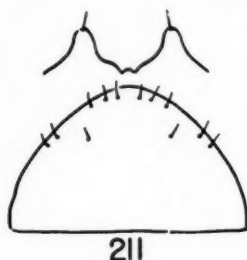
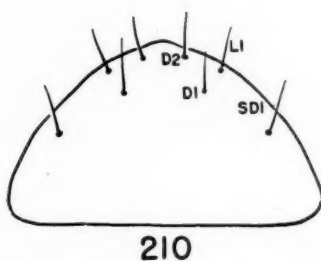
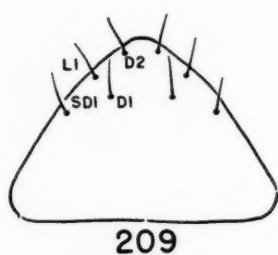


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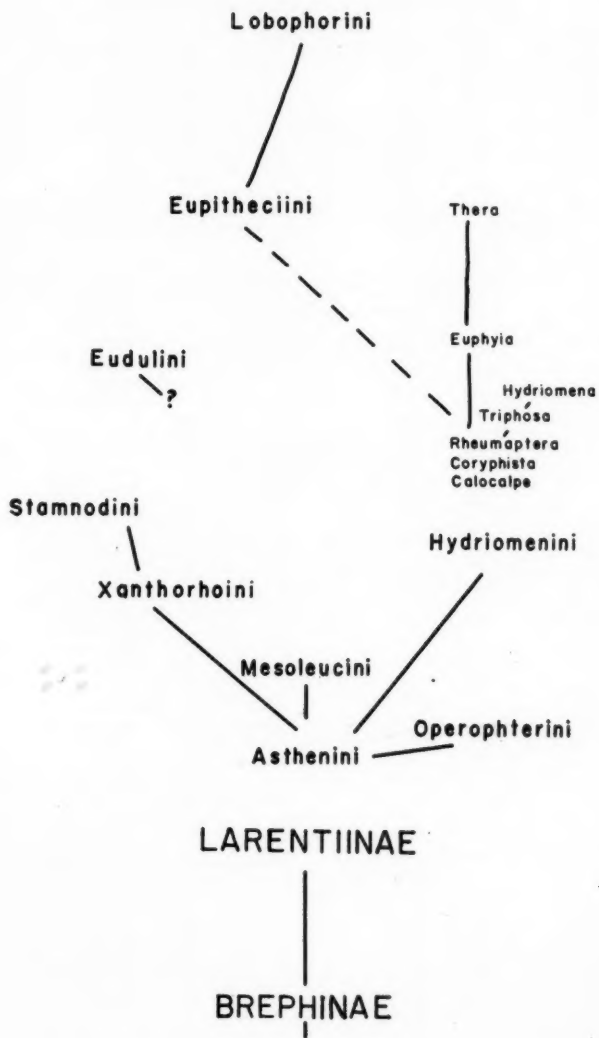
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